DISCOVERY

A Monthly Popular Journal of Knowledge

JULY, 1932.

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"SCIENCE AND THE EMPIRE"

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Notes of the Month.

Throughout the Empire attention is being focussed on the Imperial Conference at Ottawa. While economic problems will naturally be foremost, it is an appropriate time to consider the progress of research overseas. "Science and the Empire" is therefore the theme of our editorial pages this month. It is naturally impossible to include within the space of a single number an account of Empire research in all its aspects. The field is limitless and is growing all the time. But we have endeavoured to select certain branches of work in which progress has been outstanding in recent years. The Empire universities and similar institutions have naturally played a prominent part, and it is with this field that Sir Stephen Tallents deals on another page.

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The most valuable contributions to science overseas have inevitably been in the field of agriculture, and increasing attention is being given to the study of pests in relation to crops. Insects have been estimated to destroy one-tenth of the world's crops and one-fifth of all tropical production. In the Empire alone they annually destroy sufficient food to support 45,000,000 people. Less than 300 entomologists are at present employed in the Empire to combat the pests and a little over £500,000 is spent annually on defence measures. Although this service is the most efficient in the world, the need for more adequate measures is clearly urgent. The problem of fungous pests is no less pressing. Plant diseases mainly caused by fungi involve an annual loss to Australia of about £7,000,000 and have been known to wipe out an entire crop. There is a rapidly growing interest in mycology overseas, but the science is still young and thousands of fungi are not yet identified. Notable advance has been made in the knowledge of bacteriology, but many diseases of plants and animals still elude control. At the moment the chief interest lies in the study of virus diseases, which have been the subject of recent articles in *Discovery*. Research is being followed up in many Empire stations, although it is being concentrated mainly in this country.

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Empire scientists have at least one important lesson to teach the politicians who are meeting this month at Ottawa. As Sir Stephen shows, the interchange of information, the spirit of give and take, for which the political leaders are seeking, is already a commonplace in the scientific world.

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This number would not be complete without mention of the problems which face the anthropologist in Africa. Arrangements for the Five-Year Research Plan of the International African Institute were outlined in *Discovery* last March. No one is more qualified than Lord Lugard to discuss the nature and scope of the work now that fuller details are known. The research students of the Institute will primarily be concerned in studying the effect of European contact with the tribal system, and with the forces which are bringing about the disintegration of native society. If the plan is to succeed it must be conducted by trained anthropologists who are fluent in the language. As Lord Lugard explains in his article, the Institute is precluded from interference in policy. The work must be approached as an objective and scientific study of the facts as they exist, which must be allowed to speak for themselves to those who are responsible for policy. It is to be hoped that those engaged in native administration will co-operate to the full with the Institute's plan, and will be

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more ready than some have been in the past to avail themselves of the results.

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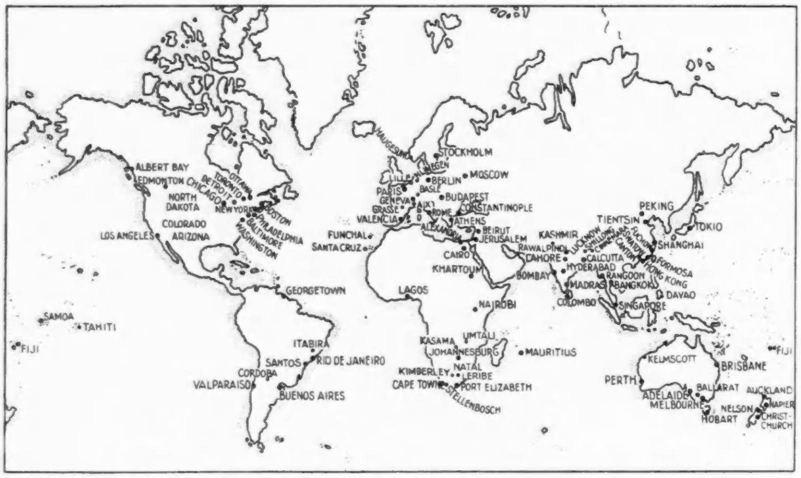
It is literally true that *Discovery* is read in every corner of the Empire, and letters from overseas subscribers reach us from places as far apart as Brisbane and the Fiji Islands. We believe therefore that this issue will be of particular interest to our readers in the Empire, some of whose addresses are shown on the accompanying map. We have always regarded "stunts" as out of keeping with serious journalism, and we believe that *Discovery* needs none of the attractions with which some of the newspapers beguile a trusting public. But to provide a closer link between our readers at home and overseas, we propose to offer one year's free subscription to the senders of the first six letters which reach this office from the most distant places abroad. Where a prize-winner is already a subscriber, his existing subscription will be extended for a further year. Letters should reach us not later than October 1st, and it is hoped to publish a selection in a later issue.



THE ADDRESSES OF SOME OF OUR OVERSEAS SUBSCRIBERS IN ALL PARTS OF THE EMPIRE.

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A new milestone has been laid (if that is a correct metaphor) in the history of television by the televising of the Derby, of which an account appears on another page. Even the most sanguine supporters of television hardly expected such excellent results as were actually obtained, and the clerk of the weather must be thanked for providing an ideal day for the experiment, which was accomplished in the face of conditions largely outside the control of the television engineers. Although Epsom is only fourteen miles from London, the signals had to be sent over about thirty miles of public telephone cable, at a time when all the lines were fully occupied. Not long before the race a breakdown occurred and a dozen Post Office engineers were rushed to the rescue. Another difficulty was presented by the position of the television apparatus. The best sites on the course were secured by the cinema and Press photographers, and Mr. John Thorne, who directed the broadcast, had to work under very crowded conditions. The real triumph of the Derby experiment was in proving that a transmission can now be carried out under practical conditions of the most severe kind.

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The arrangements for television broadcasts by the B.B.C. are not yet complete, but it is clear that the transmissions will be conducted under ideal conditions, which will contribute a great deal to their successful development. Broadcasting House has been described as the world's largest "entertainment factory." Its capacity is indicated by the control room, which is capable of handling eight rehearsal programmes and six transmission programmes simultaneously. There are twenty-two studios, complete with separate waiting-rooms for the artists.

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The possibilities of the aeroplane in agriculture are being explored in Russia, notably in the rice fields of the North Caucausus. According to the Moscow correspondent of the *Observer*, one striking advantage of sowing seeds from the air is the speed which it develops. A hectare can be sprinkled with seed in less than a minute. The harvest-yield in the rice fields increased after the air sowings, and this year the rice area which will be sown in this way will amount to 7,000 hectares. Speed in sowing is very important in the arid regions of South-eastern Russia and Russian Central Asia, which habitually suffer from insufficient rainfall. A main disadvantage of air sowing lies in the fact that it has so far proved impossible to distribute seed evenly. Until this can be remedied the method is recommended primarily for crops like rice, where the hand planting is very laborious.

The Progress of Empire Research.

By Sir Stephen Tallents, K.C.M.G.

The Empire's political leaders are meeting at Ottawa this month to draw up a plan for closer co-operation in the field of economics. In reviewing the progress of research at the Empire universities and kindred institutions overseas, Sir Stephen Tallents shows how the scientists are setting an example which might well be followed by the politicians.

It is easy for us in these industrial islands to forget that we are part of an agricultural Empire. But in most overseas countries, temperate or tropical, agriculture is the beginning and end of prosperity.

Scientific research overseas naturally reflects the economic orientation of the Empire. Its most numerous and valuable contributions have lain in the field of agricultural and veterinary work. This does not mean, of course, that research in other fields is lacking or unimportant. One has only to mention Dr. Banting's famous work on the insulin cure for diabetes at Toronto, or Sir Venkata Raman's physical and mathematical discoveries at Calcutta (which include the discovery of the "Raman effect" well known in connexion with atomic physics), to realize that research workers overseas are adding significantly to knowledge in many fields other than that of agriculture.

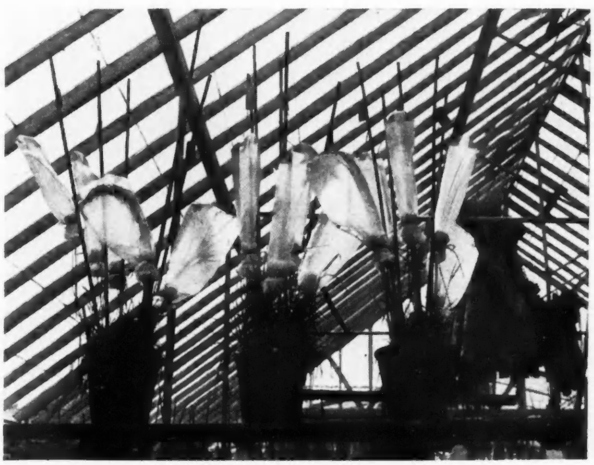
Again, in the tropics, tremendous advances are being made both in the fundamental study of tropical diseases, and in the control of widespread infections such as malaria and trypanosomiasis. Nor has the industrial field been neglected. Canada, in particular—as befits the most industrialized country in the oversea Empire—is devoting more and more attention to industrial research. But it is to agriculture, in its broadest sense, that the main part of the funds and of the man power available for research has been devoted.

There is no clearly defined thread linking the widely scattered and diverse enquiries in progress overseas. But if I were to generalize I would say that they fall into two classes: offensive and defensive. The offensive branch deals with the improvement of crops and animals. Science in the past has bred new, quick-maturing wheats which have pushed the boundaries of cultivation far northwards into Canada, and drought resistant wheats which have conquered the semi-arid plains of Australia. It has discovered how to nourish plants with food conjured out of the air. It has bred cows which will yield 2,000 gallons of milk from ancestors whose maximum was 200 gallons. It has evolved methods of extending the life of an apple or the sweetness of a sheep's carcase from weeks into months, or even into years.

But, great as is the revolution which science has brought about in agriculture, we have only reached the beginning. The principles of plant breeding which have added so enormously to the productive powers of the world are now being applied to other crops, such as grass and sugar. Plant-breeding itself is being revolutionized by the discoveries of the cytologist. The methods we use to improve our fruit trees have yet to be adapted to tropical trees such as rubber, cocoa and oil palms.

We are on the verge of a new knowledge of the functions of the ductless glands which may give us a far more drastic control over animal production. Cows may be made to produce milk without calves, steers to mature in half the normal time, and sheep to double their yield of wool, by a simple injection. But speculation is dangerous; the offensive weapons of scientists are so powerful that no one can predict where their next shell will land. The biochemist, the plant-breeder and the geneticist are (I should say) the men behind the big guns.

The defensive arm of the Empire's scientific forces is no less important. Its

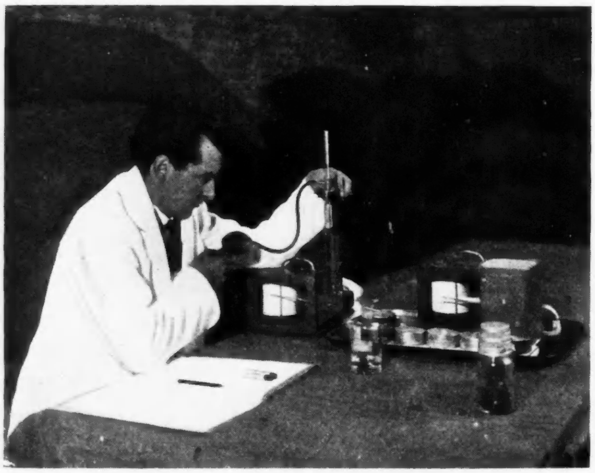


PEDIGREE GRASS PLANTS.

The improved strains of grasses bred by Professor Stapledon and his team of research workers at Aberystwyth, are finding a widespread application in the Empire.

squadrons are composed of entomologists, mycologists and bacteriologists who are striving to free mankind from the payment of a colossal toll to pests and diseases. Insects are said to destroy one-tenth of all the world's crops, and one-fifth of all tropical production. Every year insects actually destroy, in the Empire alone, enough food to support 45,000,000 people. In Canada it has been reckoned that they do £30,000,000 worth of damage annually to fruit and crops, and in Australia the figure is proportionate. The expansion of cultivated areas in any part of the world provides a new opportunity for countless millions of insect appetites to find satisfaction. Against this the Empire as a whole supports an entomological defence force of less than 300 men and spends annually on defence measures about £569,000—still an inadequate though a very efficient insect police force.

The situation as regards fungous pests is little better. Plant diseases, caused in the main by fungi, share with insect pests the position of the crop farmer's most dreaded enemy. They cause an annual loss to Australia of about £7,000,000, and may, on occasion (a famous instance is coffee-leaf disease in Ceylon) wipe out an entire crop. Mycology is a very young science. Thousands of fungi are not yet identified. There is, however, a rapidly growing interest in this science overseas. There remains the third class of defensive scientist—the bacteriologist. His triumphs in human health have been great, but many diseases of plants and animals still elude him. He has found vaccines to protect cattle against the deadly scourges of rinderpest and anthrax, which once, during their periodic outbreaks, swept millions of animals out of existence and left behind a trail of rotting bones and starving villagers; but many diseases, such as trypanosomiasis and heartwater, foot-and-mouth disease and East Coast fever, are not yet under control.



INSECT DAMAGE.
Taking the "dew-point" in a wharf warehouse at the Stored Products Laboratory, Slough, to find the humidity at which insects breed most rapidly.

At the moment the chief interest lies, perhaps, in the study of virus diseases. Virus borne infections such as foot-and-mouth disease in animals and the various mosaic diseases of plants cause enormous losses and anxiety overseas. Research (which is trying mainly to solve the fundamental problem and the nature of viruses) is being followed up in several Empire research centres, although—by reason of the elaborate apparatus and years of time required—it is at present concentrated mainly in this country.

How is all this research organized and carried out? In the first place there are over sixty universities and independent colleges in the oversea Empire, attended by something like 120,000 full-time students. Canada alone has over twenty, and India comes second with eighteen. Universities flourish not only in all the great Dominions but in imperial outposts such as Hong Kong, Malta, Ceylon and Singapore. Most of the smaller universities, of course, are of necessity confined purely to teaching; but in many of the larger ones, such as Toronto, McGill, Alberta, British Columbia, Sydney, Melbourne, Cape Town, Stellenbosch, Witwatersrand, and New Zealand (to name only a few at random) a great deal of biological research is in progress. Toronto University, for instance, has one of the best medical schools in the world, and attracts students from America and England as well as from all over Canada; and Collip's discoveries at McGill concerning the secretions of the endocrine glands are internationally famous.

Probably few people in this country, with the exception of the (fortunately) growing number of scientists who have actually paid a professional visit to Canada, realize the extent to which the Dominion is backing agricultural and biological research. The size, the equipment, the resources of, say, the Universities of Alberta and Saskatchewan astonish the English visitors, who are not prepared to expect such lavish outlay and such thorough-going and imposing experimental farms. The latest development of agricultural research in Canada is the setting up of an Institute of Parasitology at MacDonald College,

St. Anne de Bellevue, in Quebec. Internal parasites have been estimated to kill one-tenth of Canada's livestock every year, and to cause an annual loss to the Dominion of £4,000,000.

PARASITES OF WHEAT SAWFLY.
Packing a consignment of parasites of the wheat stem sawfly for dispatch to Canada, at the Farnham Royal Parasite Breeding Laboratory.

Canada, of course, is no worse off than other Empire countries where a big livestock industry exists. Parasites are, in fact, one of the stock-farmer's biggest problems all over the Empire, and parasitic infection is believed to be dangerously on the increase. It is hoped that research in this new Institute, whose buildings are now in course of erection, will benefit farmers all over the Empire, and for this reason the Empire Marketing Board is co-operating with the Canadian Government in supporting the present scheme.

Governments have, for many years, considered it their duty to encourage useful research by grants to universities and other institutions. It is only comparatively recently, however, that they have plunged wholesale both into the setting up of research stations and the organization of research on a national scale. Canada, Australia and New Zealand have all started, during or since the war, specialist branches of Government to direct, stimulate and, if necessary, actively undertake research.

In Canada, for instance, the National Research Council is directly responsible to the Canadian Government, from which it received, last year, a grant of $500,000. The Council was set up in 1917 to give *ad hoc* grants to universities and other centres, to award scholarships to promising graduates, and to encourage co-operation by setting up Associate Committees to deal with special subjects such as rust in wheat, tuberculosis, helium, aeronautics, coal, magnesite, grain, and so on. (There are now twenty-nine such committees.)

In 1924 the Council was strengthened and given an ambitious mandate "to promote the utilization of the natural resources of Canada." It then decided to build its own laboratories at Ottawa. Dr. H. M. Tory, the President, visited the leading research institutes of Great Britain, Germany, Japan and France to collect ideas and to study their organization. The laboratories, which cost $3,000,000 to build and which are among the most up-to-date in the world, were formally opened a month ago. A programme of research in chemistry, physics, biology, aeronautics and textiles has already been begun.

Rust has been estimated to destroy £5,000,000 worth of wheat every year in Canada, and in 1916 (a bad year) the loss actually amounted to £30,000,000. A determined attack is being made on this problem at the Dominion Rust Research Laboratories at Ottawa, under Dr. Craigie. Even aeroplanes are now being used as an arm of research. They are sent up to trap rust spores at varying heights, in order to map their paths and seasonal drift, and so to show how the Canadian wheat-fields are infected by spores blown by the wind, perhaps across half a continent.

Other branches of applied agricultural research are also the special charge of the Federal Department of Agriculture. The Department runs a network of experimental farms throughout Canada where every sort of practical problem comes under review. The Dominion fruit research stations at Summerland, in British Columbia, for instance, and at Vinelands, in Vancouver Island, are famous among fruit experts in all parts of the Empire. An exchange was recently arranged between a worker from Summerland and another from the Horticultural Research Station at East Malling, in Kent.

The best utilization of Canada's lumber resources, the control of forest pests and diseases, forest husbandry and other timber problems are the concern of the Dominion Forest Products Laboratory at Vancouver, which ranks with Dehra Dun (India), Wisconsin (U.S.A.), and Princes Risborough (England) among the leading timber research stations in existence to-day. Close co-operation is maintained with our own Forest Products Laboratory at Princes Risborough. There are, in addition, four fisheries

research stations maintained by the Federal authorities; two on the Atlantic coast and two on the Pacific. Provincial Governments, as well as the Federal Government, are spending steadily increasing sums on research. The Ontario Research Foundation, for instance, is supporting research on meat packing, metals, the woollen industry, leather, fuel, and other subjects.

The Commonwealth Council for Scientific and Industrial Research has established in Australia, since it was set up in 1926, a network of scientific investigations dealing with major problems of the primary industries. The Council, whose Chief Executive Officer is Dr. A. C. D. Rivett, has six divisions — plant industry, animal husbandry, animal health, entomology, soil science, and forest products.

It is now intended to add a seventh division for low temperature research, and to place it under Dr. J. C. Vickery, an Australian scientist who recently spent three years at the Low Temperature Research Station at Cambridge. (He also headed a recent imperial expedition to New Zealand to study the freezing and transport of mutton and lamb.) This is, I think, a good example of the sort of team-work in scientific research which is one of the most remarkable and most encouraging developments in post-war Imperial relations.

A short time ago the McMaster Laboratories, the gift of a public-spirited pastoralist, were established near Sydney for animal health research, and now, under a new scheme jointly financed by the Council and the Empire Marketing Board, an experimental farm in Queensland has been bought and stocked for an ambitious attack on animal diseases. The conquest of a single disease (and there are scores to tackle) may repay many times the expense of research. Recently, for instance, one of the Council's staff discovered a vaccine for "black disease" of sheep. It is estimated that this disease causes a loss of £1,000,000 a year, practically all of which will now, it is hoped, be saved.

AMANI RESEARCH STATION.
Research workers at Amani, East Africa, are breaking new ground in the study of hitherto untouched problems, such as the peculiarities of East African soils.

Animal nutrition research is centred at the Waite Institute, at Adelaide, under the direction of Professor Richardson. Results of the greatest significance to Australian sheep-farmers are being obtained here; for instance, the feeding of supplementary protein rations to sheep in times of drought has been shown to increase the yield of wool by 30 per cent at a comparatively trifling cost. An investigation on the mineral contents of natural pastures in relation to the health and productivity of grazing animals (which links up with similar research centred under Dr. J. B. Orr, F.R.S., at the Rowett Research Institute in Scotland, and also being carried out in New Zealand, South Africa, Kenya and the Falkland Islands) is also giving important results. This has already shown that, if the missing mineral element is made up in an artificial fertilizer, the stock-carrying capacity of certain pastures may be doubled; and that animals grazing on "deficient" pastures may be protected from disease, and their health enormously improved, by the feeding of mineral supplements.

The entomological division has to guard the fruit, livestock, dairy and cereal farmer against the ravages of insects, one of which alone—the sheep blowfly—is reliably estimated to do £4,000,000 worth of damage every year. The buffalo fly is another extremely serious pest, in this case of the cattle industry. Australian scientists have recently visited Java to obtain a parasitic fly which may help to suppress its activities. Australia is, of course, the scene of one of the classical successes of "biological control"—the checking of the prickly pear pest by the insect *Cactoblastis cactorum* (imported from South America) which resulted in the releasing of over 2,000,000 acres of land from the grip of this rapacious weed.

Grass is by far the Empire's greatest crop, and its improvement—still an almost untouched subject—holds out enormous future promise. It has been suggested, on good authority, that the yield of the Empire's grasslands could, by scientific treatment,

be doubled. The focus of grassland research for the whole Empire lies, curiously enough, on the slopes of the Welsh mountains.

The gospel preached by Professor Stapledon and his team at the Welsh Plant Breeding Station at Aberystwyth, together with the improved strains of grasses bred by him, are spreading far and wide. One disciple is at present spending a year in Australia. This officer—a sort of St. Paul among pastoralists—was previously " lent " for two years to New Zealand, where a new centre for the propagation of the doctrine — a plant breeding station on the Aberystwyth model — was being created.

New Zealand, like Australia, is well served by her scientific department of state. Its divisions cover everything from geophysics and petrology to *Phormium tenax* and fruit. There is a dairy research institute at Palmerston North, where practical problems such as " openness " in cheese and dairy bacteriology are studied, and which maintains close contact with the National Institute for Research in Dairying near Reading. There is a fruit research scheme which draws upon the technique and experience of East Malling—whose director, Mr. R. G. Hatton, recently visited New Zealand for assistance and planning. (The famous East Malling rootstocks are being extensively established in the Dominion.) Research is carried out on the mineral contents of pastures, the freezing of meat, the diseases of apples, and a dozen other problems.

New Zealand entomologists at the Cawthron Institute are seeking and receiving help from the Parasite Breeding Laboratories, under Dr. W. R. Thompson, at Farnham Royal, in the search for insects to control certain " noxious weeds," such as the blackberry, gorse and ragwort, which steal thousands of acres from the New Zealand farmer.

Agricultural research in South Africa is largely carried out under the aegis of the Union Department of Agriculture, and also at Stellenbosch and Pretoria Universities. The fame of the Veterinary Laboratories at Onderstepoort, under the directorship of Dr. P. J. du Toit, is widespread. Onderstepoort has come to be regarded as the leading centre for veterinary research not only on the African Continent but all over the Empire.

COFFEE FACTORY AT AMANI.

The effect of shade on the growing of coffee is among the problems studied at the factory shown in the above photograph, which also includes the saw-mills.

Two thousand miles or so north of Onderstepoort there is another link in the still unforged chain of imperial research stations. This is Amani, the old German scientific outposts in Tanganyika. Re-equipped and re-staffed, it is now breaking new ground in its study of a dozen urgent and hitherto untouched African problems, as, for instance, the improvement of sisal by breeding, the effect of shade on coffee, and the varying needs and peculiarities of East African soils. There remains a third link in this research chain — the Imperial College of Tropical Agriculture in Trinidad. As the only tropical training ground for agricultural and specialist officers whose careers are to be devoted to the improvement of agriculture in the Colonies, the College holds a key position in the imperial structure.

The Empire's political leaders are meeting this month at Ottawa to draw up a plan for closer imperial co-operation in the field of economics. I think that the scientists may well claim to have set an example to the politicians. The very machinery for interchange of information, the system of give and take, for which the political leaders are seeking is already (although to a limited and imperfect extent) in operation in the scientific world.

Among the outward and visible signs of this co-operation one must, I think, mention the Empire Marketing Board, which, since its inception in 1926, has spent some £1,235,000 in grants for research both at home and in nineteen oversea countries. We, in this country, have a special responsibility towards the scientific workers of the Empire overseas. If we are to maintain our leadership we must not rest upon our own well-worn cultural laurels. We must take and keep our place as the imperial centre of the new culture of scientific research and its application to human needs.

The Five-Year Research Plan in Africa.

By the Rt. Hon. Lord Lugard.

As announced in DISCOVERY *last March, the African Institute is embarking on a five-year plan of research into the changing conditions which have led to the disintegration of native society. A detailed study of native traditions will be made, and the effect of European contact on the tribal system will be observed from new aspects.*

THE International Institute of African Languages and Cultures was inaugurated six years ago as a central co-ordinating agency for the hitherto disconnected research in various countries into problems of African sociology, linguistics and anthropology. It has the special object of placing the results of such research at the disposal of the administrator, the missionary, the settler, and those engaged in commerce and industry in Africa, in a form in which it should be of practical use. In the prosecution of this task it may claim some success, for its governing body includes representatives of the principal societies (thirty in all) engaged in such work in Europe, America and Africa, twenty-two African Governments have contributed to its funds, and its executive council has worked in complete harmony—a result largely due to its Secretary-General, Major Vischer.

THE WITCH DOCTOR.
The new religious teaching brought by the white man has struck at the roots of the African's spiritual beliefs, in which the witch doctor played so important a part.

In addition to the advice and information given to many hundreds of enquiries, it has published a number of works; it has issued a practical orthography for the writing of African languages, and assisted several Governments in the solution of linguistic problems by the personal visits of Professor Westermann (a Director), and its journal *Africa* may claim to have maintained a high standard.

It is not, however, with the past work of the Institute that this short article is primarily concerned. It suffices to say that the Directors of the Rockefeller Foundation, whose standards are exacting, were satisfied that it had "made good" and was worthy of support. They decided to make a very generous grant (as Mr. Fallaize has described in his very interesting article in the March issue of this journal), for five years to enable the Institute while carrying on its present work to embark on a project of research of its own. Readers of *Discovery* may be interested to hear something of the nature and scope of this project.

The old conception that Africa was peopled by savages who knew no law or restraint other than the temporary cohesion necessary for attack or defence has now given place to some appreciation—as yet very vague—that the constitution of African Society imposed its own restraints and obligations. Research, so far as it has gone, demonstrates that the individuals who form the tribe are subject to a very effective discipline based in part on custom and tradition which had its roots in social welfare, in part—perhaps the dominant part—on deep-seated beliefs pertaining to the spirit world, and the influence on the living of the spirits of the dead. The religious teaching and the education brought by the white man struck at the roots of the spiritual beliefs and sanctions which were so potent an agency in the maintenance of tribal authority, while on the other hand every feature of economic development has tended to substitute individual gain and personal responsibility for the communal African society.

To say that Africa is in a state of transition has become a platitude. The advent of Europe with its professions of Trusteeship, its missionaries and educators on the one hand, and its merchants, mining companies and planters on the other, has had a profoundly disintegrating effect, not only on the primitive tribes of Africa, for centuries isolated from contact with the outer world, but equally—though with a difference—on those more advanced communities which had already adopted the creed of Islam.

Administrators of vision have sought to find means to avert the chaos which must inevitably follow

the breakdown of the old tribal discipline, by endeavouring to maintain the integrity of the tribe and to support the authority of its leaders, by vesting them with secular powers to replace as far as possible the decay of spiritual authority. To the Council of the International African Institute it seemed that no more important field for research, or one more likely to yield practical results alike for the administrator, the missionary and for those engaged in the economic development of Africa, could be found than an investigation of the nature and effect of the forces of disintegration upon the fabric of African Society.

Such an investigation must necessarily involve an intensive and prolonged study of African social conditions, of tribal law, traditions, beliefs and sanctions as they existed prior to the advent of foreign influences in order to appreciate the changes which those influences had introduced. The investigation must be conducted by men or women trained in scientific methods and by temperament able to co-operate with all who are working in the same field, whether in an official or an unofficial capacity, including educated Africans. They must have a knowledge of the technique of anthropology and acquire a fluent knowledge of the language by which alone it is possible to appreciate not merely visible phenomena, but the motives which are the causes of those phenomena—not merely, for instance, the obedience and loyalty to the Chief, or the fact that large numbers of adults are willing to leave their homes and seek wage-labour, but the motives which prompt them to do so.

The Institute, by the terms of its Constitution, is precluded from any interference in policy. Its

AN AFRICAN VILLAGE.
One of the problems to be studied by research students is the effect on village arts and crafts of the influx of cheap foreign goods and patterns.

NATIVE FISHERMEN
The photograph shows one of the enormous nets used by the natives in river fishing. European methods are tending to displace native customs in every phase of life.

representative must approach his task with the sole desire to make an objective and scientific study of the facts as they exist. He must let them speak for themselves to those who are responsible for policy, in the hope that they may the better appreciate the effects of the interpenetration of African life by the new ideas and the economic forces which European civilization has brought to bear upon primitive society. He must support his conclusions regarding racial and linguistic affinities by statistics, maps and diagrams, and comparative data as to regional *tabus*, folk-lore, etc.

Professor Malinowski has described in *Africa* (January, 1929) the methods of anthropological research which the Institute in accordance with its fundamental objective believes are most likely to produce results of practical value. But it may be of interest to the general reader to describe very briefly the kind of work in which the research student will be engaged. Starting from the family—the pivot of the social system—he will study its inter-relations with the clan and the tribe, the basis of the authority vested by each in its head, and the method by which that authority is exercised, whether by the village elders or the advisers of the Chief. He will inform himself regarding the relations of the sexes and the duties assigned to each, the religious beliefs and symbolic rites, the system of tribal education and the significance of the initiation ceremonies and age-classes. He will endeavour to master the African point of view in regard to land and its products, and learn what he can of native methods of treating disease.

When he feels that he has acquired some grasp of such factors as these in native life he will be able to

observe the effect which European contact has had, not only in modifying traditional customs but more particularly on the psychology and mentality of the people. He will, for instance, want to know what is the average number and the proportion of men, women, and children in the family unit. How far the authority of the Chief and Elders has been undermined by the new ideas, and by what means they have attempted to reassert it?

Many Problems.

What are the incentives to wage-labour, or the acquisition of individual wealth by the cultivation of crops for sale, and what change has this new individualism effected in social relations, and in the division of work between the sexes? To what extent has foreign education and religious teaching broken down the fear of witch-craft or belief in the influence and power of departed spirits. Has the ability to travel and mix with other tribes and the consequent cessation of tribal obligations and sanctions experienced by absentee members had any disruptive effect on their return, and how far has the absence of many adult males changed the social and family life? Have the new ideas given rise to any new adjustments of the family and clan system?

What is the effect on village arts and crafts of the influx of cheap foreign goods and patterns? Has the conception of individual tenure of land and its sale in perpetuity as a commodity penetrated the native mind? If land has been alienated to Europeans or if Native Reserves have been created, what has been the effect on tribal life, and what is the area of cultivable and of grazing land available per family? What is the cause which has led a number of families to become tenants or "squatters" on European estates, and do they maintain any touch with and allegiance to their tribe? These and a thousand similar subjects of enquiry and study will be dealt with in the monographs prepared by the research student. Many of the most fruitful fields of enquiry will lie in the special domain of women if they can gain the confidence of their own sex.

The selection of candidates for the few research fellowships which the Institute is able to offer is obviously a matter of the greatest possible importance, and there is a wide field in Europe and America from which to choose. This most difficult task has been undertaken by Dr. Oldham, subject, of course, to the final scrutiny and approval of the Executive Council. In some cases a very promising candidate for a fellowship has been chosen subject to his going through a special course of anthropology.

Of the two Directors of the Institute, M. Labouret is himself undertaking a tour of French West Africa accompanied by a selected pupil from the École Coloniale, who it is hoped may become a valuable collaborator in the future. Dr. Westermann (the other Director) will probably undertake a similar tour later on. Their mission is to bespeak the co-operation and interest of the local Governments, and to further the general scheme. So cordial, however, has been the attitude of the various Governments in Africa, especially the Belgian, British, French and Italian, with the possible exception of the Portuguese and Spanish, that the Institute is assured of assistance and help for its Fellows.

Allusion has been made to the immense untapped reserves of information which exist in the experience of missionaries, administrative officers, and others whose intimate and sometimes lifelong acquaintance with the people among whom they have lived is often buried in official archives, while the public is left to gather its information about Africa from the impressions of the tourist. From them the Research-Fellow can obtain invaluable information.

The Institute publishes articles from such sources from time to time in its journal, but it is often the case that owing to lack of technical training their method of approach is unscientific—statements are unverified, and hearsay is intermixed with first-hand observation. The unusual or grotesque is more emphasized than the normal and common-place routine, on which the trained observer relies when constructing his picture of the bases common to African society, and the divergences which characterize particular tribes or are due to foreign influence. From its restricted funds the Institute has set aside a small sum to provide a few "student-ships" to enable specially valuable men of this type to go through a course while in England on leave.

European Contact.

If at the end of five years the Institute has succeeded in producing a series of monographs on selected regions, it will have done a piece of really useful work. They would include, if possible, an objective study of areas in which European settlement has taken place and those in which there is none, of areas from which there is a constant emigration for wage-labour, or in which cultivation by natives of products for export has become a feature of native life—to which may perhaps be added a study of the congested native population of one or more large cities, or the conditions of labour at a mining centre.

Science and Industry—V

The Development of Wireless.

By O. F. Brown, M.A., B.Sc.

Secretary of the Radio Research Board.

The wireless industry has always been ready to take full advantage of scientific research, and its remarkable prosperity in the recent years of depression is largely due to this co-operation. In this country the Radio Research Board has provided a valuable link between the scientist and the industry.

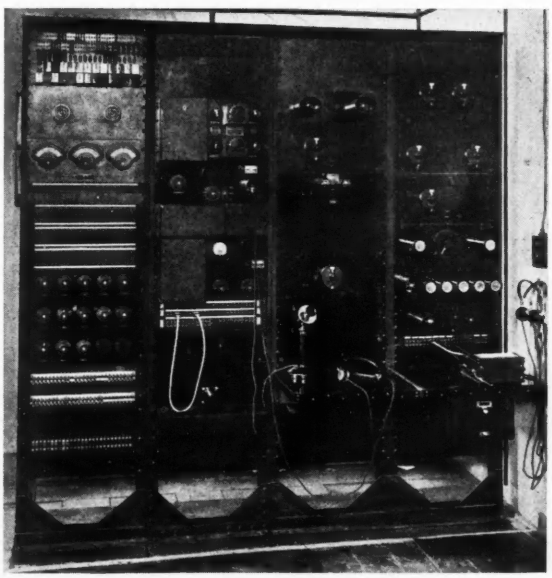
WIRELESS probably enters more intimately into everyday life than any of the many inventions whose development marked the early years of the present century. It has been well said that some industries are born from science, others have science thrust upon them. No better example of the former class could be cited than the wireless industry.

The earliest developments are well enough known and need only be briefly mentioned. In 1842 Henry discovered electrical oscillations, and in 1873 Clark Maxwell predicted the existence of electro-magnetic waves of lower frequency or longer wavelength than those which make their presence felt as heat or light. Hertz in the later 'eighties published an account of experiments in which he had successfully radiated and detected such waves. Several acute minds saw almost simultaneously in Hertz's work the germ of a new means of communication, and gradually as a result of their efforts the wireless industry came into being.

By 1901 Marconi had transmitted the signal "s" across the Atlantic, Lodge had shown the full importance of tuning or "synchronization," while through the efforts of Captain H. B. Jackson (afterwards Admiral of the Fleet Sir Henry Jackson) wireless held a definite place in the communications of the British Navy. Although by the beginning of the war the wireless industry had become firmly established, only one long-distance commercial service had been opened, namely, the Marconi Service between Clifden in Ireland and Glace Bay in Nova Scotia. It was beginning to be realized that the actual propagation of waves for long distances through the intervening space presented peculiar difficulties, the nature of which were not fully understood. Though physicists were turning their attention to these difficulties, science spoke with a very uncertain voice concerning them.

Methods of long-distance communication in use before the war and for some years after it have had very little influence on wireless as practiced to-day. It is equally true that the results achieved in long-distance communication until a very few years ago gave no indication that wireless was likely to become the effective competitor with submarine cables that it is to-day. In fact, it was frequently suggested that if wireless had been invented before cables instead of after, the submarine cable would have been regarded as a very considerable advance.

Although the war period was obviously a very unsuitable time for the careful study of any scientific problem, it had the effect of bringing the physicist and the wireless technologist into closer touch. Many of the best scientific brains in the country were for the first time permanently attracted by the fundamental problems of wireless, and many technologists realized for the first time that the methods of science were more likely in the long run to lead to lasting solutions of their problems than the empirical methods upon which they had previously relied. The alliance between practical wireless and science which was



AT THE BALDOCK RECEIVING STATION.
A modern wireless receiver built on the principle of the "unit bookcase." The transmitters are stationed at Rugby, some miles away.

established at that time has remained ever since, and is in fact becoming closer.

The starting point of modern wireless is what is known as the three-electrode thermionic valve, which was first conceived by De Forest. Besides the invention of the De Forest valve (or audion as it was then called), the two years before the war saw the introduction of the Meissner valve in Germany and of the Round valve in England. These early valves contained a small trace of gas. They were irregular in their action and required constant skilled adjustment. During the war, however, the French produced a "hard" valve in which the exhaustion of the containing vessel was carried to the highest possible extent. These hard valves were found to be very much more reliable and uniform in their action than earlier "soft" valves. Although as a result of careful scientific experiment many great improvements have been effected in the life of the valves and in their general characteristics, most of the valves made to-day are in principle very similar to the French valves in their mode of action.

The valve can now be regarded as practically stabilized as an entirely efficient instrument. The British production of valves for broadcast receivers and for other purposes last year reached the surprising figure of 6,500,000. The perfecting of the valve gave a tremendous impetus to the wireless industry, and in particular made possible the development of broadcasting and of long-distance wireless telephony, an account of which has already appeared in *Discovery*. The increase in the number of wireless services claiming wavelengths suitable for their requirements made the problem of interference acute. It became specially necessary for stations, once allocated a wavelength to transmit as exactly as possible on that wavelength. Any wandering in frequency not only causes interference and distortion, in the case of broadcast transmissions, but makes the use of highly selective receivers impossible.

Shorter Wavelengths.

The valve made it possible to generate oscillations on higher frequencies more conveniently than was possible by other means. Until the end of the war it was generally considered that the useful wavelengths for various communications lay between 200 metres and about 14,000 metres. But shortly afterwards the remarkable successes obtained by amateurs in long-distance transmission on waves below 50 metres drew general attention for the first time to the possibilities of such short waves. Experiments immediately showed that they were much better suited for long-range working than the long waves which had previously been used.

The advantages of short-wave communications were soon appreciated. The opening up of the short-wave band gave another impetus to wireless development and led to the opening of the "beam" services from this country to the Dominions. Unlike the older long-wave stations, the "beam" stations were found to be serious rivals to the cables for all but the most urgent and important traffic. The last important long-wave station using high power to be erected was Rugby, which was designed to have an input power into the aerial of about 500 kW, supplied from a bank of 52 valves working in parallel and each capable of dealing with a power of 10 kW.

Organized Research.

Although Rugby is probably the last station of its kind which will be erected, it must be remembered that in spite of the convenience of short waves for services between fixed points, a station similar to Rugby is still the only type of station which could transmit a message which could be picked up simultaneously at practically every point on the earth's surface.

In 1919 the Radio Research Board was formed under the Department of Scientific and Industrial Research and began an organized scientific attack on the problem of the propagation of waves through space. How wireless waves climbed the curvature of the earth was a problem which still defied physicists. It was known that the ordinary laws of diffraction could not explain the fact that powerful signals could be transmitted over the earth's surface for thousands of miles. The hypothesis had been early advanced that part at any rate of the energy travelled upwards through the atmosphere and was in some way deflected down again to the receiving station by some conducting layer in the upper atmosphere. Although this hypothesis was accepted by most people as reasonable, it was recognized that there was no direct experimental proof of the existence of such a layer.

This proof was first supplied by experiments carried out by Professor E. V. Appleton in 1925 in conjunction with the Radio Research Board. In Appleton's experiments the frequency of continuous waves sent out from a transmitter was varied regularly by a small amount for a few seconds. At a receiving station he obtained photographic records of the interference "fringes" produced by the interaction of the waves reaching the receiver along the ground and those reaching it after being deviated back to earth from the upper atmosphere. By counting the

THE RUGBY TRANSMITTING STATION.
The main transmitter at Rugby, the only type of station capable of sending a message which can be picked up at any point simultaneously.

number of fringes produced he was able to deduce, by application of the ordinary laws of optics, the equivalent height of the upper layer.

Starting from this point, our knowledge of the upper atmosphere has progressed rapidly. It was shown that one ionized layer (the Heaviside Layer) occurs at about 100 kms. above the earth. The electron density in it was found to decrease after sunset and during the night. Further experiments, however, conclusively showed the presence of a second layer at about 230 kms. above the earth, bending back waves which had penetrated the lower layer.

The effect of ionization in the atmosphere on wireless waves passing through it had been studied theoretically by Eccles as early as 1912 and later by Larmor. Their work had shown that the bending produced by electrons should depend on the number of electrons present, the number necessary for bending the waves back to the earth increasing with the frequency of the waves. The bending was also shown to depend on the angle at which the wave train entered the layer.

It was now possible to confirm these predictions experimentally. As was to be expected, the short waves were found to pass through the low layer and to be returned from the second layer. Medium waves were found to be bent back by the lower layer by day and by the upper layer by night. By sending waves vertically upwards, estimates are now being obtained for the electron density by determining the shortest waves just returned to earth. Waves below a certain wavelength (which appears to be about 6 to 7 metres) will never be returned in ordinary circumstances from the layer and will thus be useless for long distance communications.

Recent research has shown also that owing to the effects of the earth's magnetic field the layers do not act like glass in refracting rays entering them, but like iceland spar in that they are doubly refracting. A ray from a transmitting station entering the layer is divided into two parts, one of which escapes into space while the other is returned to earth. As in the case of light passing through iceland spar, the two rays are oppositely polarized, the polarization being circular or elliptical. Hence, the directions of the forces in the wave front are twisted on reaching the earth. Accurate determinations of the amount of this twisting are now being made for short waves by means of the ingenious use, due to Mr. R. A. Watson Watt and Professor Appleton, of the cathode ray oscillograph.

The mathematical work of Professor Hartree of Manchester University and Dr. Mary Taylor of the Radio Research Station is leading to the development of mathematical expressions representing the effect of the earth's magnetic field on waves of various frequencies passing through the ionized medium. Gradually data are being collected from experimental work which should enable these expressions to be reduced to numerical formulae which could be used by engineers in specifying the best wave to employ for any particular service. Already the experimental work is being applied by wireless engineers in the design of aerial systems capable of giving the best results under the conditions in which the waves of various frequencies are returned to earth. In particular, the work has had an important application in improving the accuracy of direction-finding apparatus used at sea and with aircraft.

"Atmospherics."

The Radio Research Board has also studied "atmospherics," which are one of the most troublesome sources of interference in wireless communication, especially in the tropics. Up to a few years ago hundreds of patents had been taken out by various people all over the world for apparatus claiming to eliminate atmospherics, none of which has proved of practical value.

Again by using the cathode ray oscillograph, Watson Watt has investigated the wave-form of atmospherics and established means for determining the direction of arrival of atmospherics. The work has shown that it will probably never be possible entirely to prevent atmospherics from entering a wireless receiver. It has been shown, however, that their effect can be mitigated by making the receiver very selective and

by employing receiving aerials designed so as not to receive from the most disturbed directions.

It has only been possible to indicate in this article a few of the applications of pure science which have played a part in the development of the wireless industry. Many more instances could have been given. For example, the amplification of short waves presents special difficulties. In dealing with them the principle of "beats" is daily employed. The short waves entering a receiver are converted into waves of lower frequency by producing "beats" between the original frequency and oscillations from a small local generator. Much mathematical work has been done on the design of arrangements of inductances and condensers grouped together to form "filter circuits" which, according to the arrangements used, pass only a given band of frequencies or refuse to pass waves below or above a given frequency. By the application of these two principles the group of frequencies making up a speech sound can be mixed up in such a way as to make speech entirely unintelligible when it is transmitted by wireless until the frequencies have been correctly rearranged again in the receiver. In this way secret telephony has been practically solved.

The wireless industry is probably the most amenable to research of all our more important industries. Scientists therefore find special satisfaction in the fact that the wireless industry is one of the few which have prospered and increased in this time of general depression. In 1931, for example, in this country alone, some 1,250,000 receiving sets were sold and the year's total trading advanced from about £20,000,000 in 1930 to £30,000,000 in 1931. With the number of broadcast listeners steadily increasing, there is every reason to hope that this figure will be maintained if not exceeded during the present year.

The Study of Tropical Diseases.

PROGRESS in the study of tropical diseases has chiefly been concerned with the development of the remarkable discoveries made at the close of last century. Recent years have not been marked by spectacular advance, but much useful work has been done in developing methods of diagnosis and treatment and in studying new methods of control. Much valuable work is being done by the Bureau of Hygiene and Tropical Diseases in bringing the results of new research to the knowledge of the Empire overseas.

Some years ago, when outbreaks of sleeping sickness in parts of Africa threatened the extermination of the population of whole areas, it was realized that the isolation in which medical officers worked made a central organization necessary for publishing the results of new research in Europe and elsewhere. The Colonial Office therefore established a Sleeping Sickness Bureau to provide a link between research workers and medical officers in the field. The success of this pioneer venture led to the expansion of this organization into the Tropical Diseases Bureau, to embrace all tropical diseases. Its activities were recently again extended when it became the Bureau of Hygiene and Tropical Diseases.

The Bureau is engaged in the collection and dissemination of information from every source concerning tropical diseases, their prevalence and treatment. Summaries of new research are periodically prepared and published, and in this way new discoveries are made known with as little delay as possible.

The task of the Bureau is naturally a growing one. A close watch is kept on specialized journals published in many languages, and the output of medical literature is increasing annually. In publishing accounts of new work which might otherwise escape the majority of workers, the Bureau renders a valuable service to the medical officer in the tropics. For instance, Verbitski's outstanding work on the part played by the flea in the transmission of plague was carried out at Kronstadt and St. Petersburg, and the results were published in the Russian language in a university thesis. The work escaped notice for several years in Western Europe, and when brought to light was found to have anticipated many of the later discoveries of the British Plague Commission in India. Baermann's significant discovery that hookworm larvae harbouring in soil are not ordinarily diffused over wide areas, but tend to concentrate in moist soil, opened up fresh lines of attack and formed the basis for future research. This work was originally published in the island of Java in the Dutch East Indies.

These examples emphasize the need for a central organization to provide a focus for contemporary knowledge and to avoid waste of time and energy in overlapping. An important part of the Bureau's work is the interchange of information by correspondence. Many enquiries are received and answered, and this service is increasingly drawn upon by Colonial medical officers when the information they require is not locally available. The Bureau of Hygiene and Tropical Medicine is performing a unique service in furthering the progress of a vital branch of Empire research. No other organization is covering the same ground.

Science and Empire Fruit Growing.

By H. V. Taylor, D.Sc.

Commissioner of Horticulture to the Ministry of Agriculture.

Research has played an increasing part in the development of Empire fruit production. Quality has steadily improved, and scientific methods have led to the cultivation of many varieties in regions strange to their native surroundings.

THE possibilities of fruit production within the Empire are, of course, immense, for the demand is exceedingly large. So scattered an Empire has all kinds of soils and climates which vary from one extreme to the other. Every conceivable kind of fruit, therefore, can be produced and the people have need of all. Yet Empire fruit production is no simple affair, for to a large extent in building up the fruit industries non-indigenous fruits have been introduced and production developed by artificial methods.

For instance, the apple, which is essentially a fruit of the colder and temperate regions and thought to do best where 20 to 30 inches of annual rainfall is experienced, has been made to grow under artificial systems of irrigation in such dry climates as British Columbia and Australia. It has been made to grow in the high veldt of South Africa, where all the rain comes during the summer and practically none during the winter.

Oranges, originally natives of Asia, have been introduced to such entirely different habitats as the West Indies, New Zealand and South Africa, and by artificial methods of culture made to succeed in places quite strange to their native surroundings. Similarly, the banana has been taken far away from its native heaths, planted in torrid zones in many parts of the Empire and made to grow by a system of propagation devised to suit its cultivation in strange land.

Thus it is not surprising to find that the methods of production for a crop like the apple, far from being standardized, may vary considerably for different parts of the Empire. This has led to a realization of the effect of climate on fruit production—a science little understood and still less studied until quite recently. For long the English climate was blamed as being unsuited for dessert apples and for poor crops generally; now it is known that the humid atmosphere merely induces much wood growth, thins the sap and favours fungus pest. With this understanding has arisen the use of selected stocks to restrict tree growth, the use of potash to enable the leaves to work efficiently in manufacturing sugars to enrich the sap, and the use of sprays to control pests.

PEAR GROWING IN NEW SOUTH WALES.
The growing of pears is increasing in Australia and the quality is constantly being improved by scientific methods. The article is reproduced by courtesy of "The Fruit Grower."

In British Columbia and countries with dry atmospheres, other stocks and fertilizers have to be used to force wood growth, and other sprays used to control pests. Varying climates prevent any standardization of method, and place the grower in each part of the Empire more and more in the hands of the research worker. The aim has been to correct the effect of a particular climate on the fruit tree. Thus fruit is no longer a normal or uncontrolled product; fruit-producing has become specialized, more technical and very dependent on science. Quite naturally, perhaps, people living in the newer lands were the first to realize this and to produce on these lines.

English varieties were first planted in New England states soon after 1700 and in Nova Scotia about 1800—and became the seed bed for the other great fruit areas that came later. As the white population pushed westwards to Ontario and British Columbia and to Washington and Oregon, the fruit trees followed, and by 1880-1890 had reached the Pacific states, where they became established in the states of British Columbia, Washington and Oregon, and California, the most extensive belt of

apple orchards in the world. While apples have been grown for about 300 years in the eastern states, it has only been within recent years that the large commercial industries in the west have been built up. Thus the world's great apple plantations date only from the beginning of the present century.

British immigrants to Tasmania, Australia and New Zealand, and still later, to South Africa, have developed fruit growing in these places. In the latter, commercial fruit growing is so fresh that it must still be regarded as experimental. At all these places the first fruit used was the apple—the most in demand and the most grown.

At first the English varieties (Ribston, Blenheim, Pearmain and Russet, etc.) were grown, but growers soon learned that varieties that grew well in the temperate and humid climate of England did not give of their best when grown under other conditions. The varieties that did well in the humid climate of England were suitable for wet Nova Scotia, but not for dry British Columbia with its hot summer, nor for Australia or South Africa. From such districts the old English varieties have passed away or are producing fruit of low flavour; and in their place there have been evolved varieties peculiarly suited to each district. In England the growers are rightly proud of their Cox's Orange Pippin, Worcester Pearmain, Bramley's Seedling. These varieties give of their best in the cool, moist atmosphere of these Islands. Canada is proud of the Mackintosh Red, Delicious, Jonathan, Snow and Gravenstein, which grow better there than in England. In the far south, Australasia has Granny Smith, Cleopatra, Jonathan, Sturmer Pippin, etc., which excel. Thus the efforts in fruit growing soon demonstrated that each country had to breed and develop apple varieties suited to its climate and so to specialize in its own products.

In the United Kingdom the areas devoted to the commercial production of dessert and cooking apples are chiefly Kent, East Anglia and the West Midlands, and from all these sources the annual production varies between 4,000,000 cwts. and 7,000,000 cwts. In Canada, where the industry has much extended within the present century, in Nova Scotia, Ontario and British Columbia, the total production is nearly equal to that of England, being estimated at between 3,550,000 cwts. to 6,000,000 cwts., and many people anticipate that the time may not be far distant when the Canadian industry may expand and become larger than the home industry. In Australia, apple growing is done chiefly in Victoria and Western Australia and Tasmania, but even with the considerable expansion recently made in the two latter areas, the total production is probably only just a little over 1,000,000 cwts. In New Zealand apples are grown to some extent all over the Dominion, and in a few years the production may reach 250,000 cwts. In South Africa considerable planting of apple trees has taken place in the high veldt of the Transvaal, the Orange Free State and in Cape Colony, but as yet production is on a small scale.

Thus England and Canada still remain the centres of chief production, followed by Australia, New Zealand, and finally South Africa. In all these districts the population is increasing, the methods of the apple producer are changing, and it would be difficult to forecast the developments that will occur in each one by the end of the century. The conditions for apple production in all places are so good that before the close of the century either place might so develop as to rank first.

To a large extent this will depend as much on the adaptability of the growers to adopt modern methods

A SOUTH AFRICAN ORANGE GROVE.

Artificial methods of culture have led to the successful growing of oranges in regions strange to their native surroundings.

of spraying, fruit thinning and tree nutrition, as on the natural conditions of the country. The naturally-produced apple has ceased to be the market apple of to-day, and its place has been taken by apples from fertilized trees, lightened to bear a matured crop, and kept free of pests and diseases by spraying. Those who are prepared to do this and so produce the clean and bright skinned apples will capture the market and create the demand for further development.

APPLE ORCHARDS IN SOUTHERN AUSTRALIA.
Apples are a fruit of the colder regions, but research has enabled them to be introduced into dry climates.

Modern methods of controlled production have been used first in the newer countries—British Columbia, South Africa and New Zealand. Newcomers to an industry benefit from old mistakes, and in consequence the standard of their crops is high and the admiration of the more experienced growers of the older areas, Nova Scotia, Ontario and England. As the new methods have succeeded they have attracted attention and are now being adopted and applied in the older areas. Orchards in England and Nova Scotia, which at the beginning of the century had not known the sprayer, are now sprayed three or four times during the season and are producing fruit vastly different from the old. At first only a few orchards came to be dealt with, then many more; now the movement is spreading and in time may become general. The oldest fruit growing districts may, in fact, steadily improve their productions, and again definitely regain the position they once held. The English grower has a good climate for giving fruit of high flavour, and close at hand a public now becoming very appreciative of flavour, so that the prospects for the English industry are really good.

Pear growing is a fascinating industry, and one that the people of California commercialized for us in quite modern times. A well-grown pear always has been a luscious fruit to eat, but because of the difficulties of producing these, the supply of high-class pears has been insufficient for this fruit to become really popular. That defect is disappearing, and the good quality pear is attracting more attention. Most varieties of pears owe their origin to Belgium and France, and being bred for that climate succeed best where the summer temperature is slightly higher than in England. Even so, the annual home production is under 500,000 cwts. or about 25 per cent of our requirements.

In parts of Canada, and still more so in Australia and South Africa, where higher summer temperatures are experienced, the pear has found a home and yields splendid crops. In particular, South Africa has established its reputation as a pear growing country. The million trees or so planted in South Africa are still young and growing but suffice to show the high quality pears that can be produced.

The British people are using these pears more and more and many already see a prosperous future for their industry. Plantings to pears are increasing in England, Canada, South Africa and Australia, so further supplies are assured. These pears, too, have a value for canning purposes and this will regulate the supply sent to the market. The day has gone, however, for the low quality eating pear, and further plantings of these kinds will be discontinued. Present plantings are, as indicated, of the better kinds, and with each succeeding year the demand is likely to be for better and better varieties.

The plum is a fruit well adapted for production in colder climates, and no part of the Empire produces plums of better flavour than England. The cropping of plums, perhaps, has been somewhat irregular, but with the advent of spraying with tar distillate washes to control aphis, the plum tree can be kept healthier and thus plum growing enters a new and more promising phase.

In the warmer parts of the Empire—British Columbia, and especially South Africa—the English varieties to a large extent have made way for the Japanese plum and hybrid of the Japanese. These plums are large and distinct and to some people inferior in flavour to the English. In particular the hybrid Japanese plums suit South Africa, where over half-a-million plum trees already have been planted. Of these, the Santa Rosa predominates, to be followed by the large Kelsey and Gaviota. These are produced rather late in our season, and in consequence only have a limited market in England. But South Africa possesses distinct possibilities in plum production and some extension in acreage seems likely.

Plum production in Canada is different, for in Ontario English varieties can be grown and harvested at seasons comparable with our own, and provided faster transport and improved methods of storage become available, the plum industry may become more widely developed in Canada.

The expansion of the plum industry in all places is bound up with the progress and development of the jam and canning industries, since large quantities of plums are used for these purposes. Plum jam at one time was much used, but for some reason it is neither as popular nor as much in demand as formerly, and in consequence the demand for plums suitable for jam-making is more restricted. Canned plums, however, are finding favour with the public in all parts of the Empire, and demand is increasing for varieties suitable for this purpose.

Plums for Canning.

This demand is not without its influence on further plantings, for not all the popular kinds are ideal for canning purposes. The celebrated Victoria is excellent for canning, but the Czar is not; the Westmorland and Shropshire damson give a fine canned product, while the canned Kentish damson is poor. The capacity of all varieties for canning purposes is being appraised by workers in the research stations throughout the Empire, and the future drift of the plum industry will depend largely on their reports. The future will probably see high-class dessert plums and good canning plums steadily displace plums of lower quality.

It would be difficult to decide whether citrus or banana production has increased at the more rapid rate in recent years, for the development of both fruits during the present century has been immense. England grows (in glasshouses) only a very few oranges, but the production in the Empire is fast becoming an important industry. This fruit requires a warm climate such as is found in Spain, Italy, California, the West Indies, Palestine, and in certain parts of Australia, and South Africa and many other parts. There are very many places suitable and in which production is being tried, so that supplies are tending to exceed the demand.

Empire Oranges.

The orchards that supply England with oranges lie primarily in Spain, Palestine and South Africa, the first supplying fruit from November to April, while the South African crop is in the market from May to November. Further development and production in any part of the Empire is dependent on available markets, in which the markets of this country count for much. England grows no market oranges and is a large buyer.

Under conditions ruling at present it is difficult to see how far-away countries can compete during November to May with the Spanish orange. In Spain production is high, costs low, and transport short and relatively cheap. The industry in the West Indies and in British Guiana is already experiencing difficulty and the prospects for the orange industry there are not encouraging. The Palestine industry (mainly in the Jaffa district) is not only holding its own, but actually increasing the area by leaps and bounds, which is due to the high reputation which has been created for the Jaffa orange.

Oranges produced in South Africa and Australia come during our summer months, and escape any competition in markets in the Northern Hemisphere. The Union of South Africa is fast developing as an orange producer, and very rapidly increasing supplies may be expected from this area.

It would be wearying to describe stage by stage the developments of the other fruits. To show, for instance, how the grape-fruit industry has been developed in the West Indies, British Honduras and South Africa, to describe the efforts of Queensland and South Africa to develop pineapples comparable with those of St. Michael's; still more to relate the efforts in all parts to grow strawberries and other small fruits—raspberries, gooseberries and currants in districts far different from their natural haunts. In recent years science has increasingly been brought to bear on fruit production, and as a result the present market package bears fruit—apples, pears, oranges, bananas, strawberries or pineapples—which is far superior in quality and appearance to that marketed in the last century. Growers are coming to control by scientific means the activities of their trees and bushes so that the crops are nearer to our requirements.

A Year in Northern Rhodesia.

By Malcolm Burr, D.Sc.

Dr. Burr recently returned from a year's work in the Luano Valley, a little-known region in Northern Rhodesia of much scientific interest. Research included a study of the Orthoptera, and the collection of eight thousand specimens sent to the British Museum includes over a hundred species new to science.

AFTER trekking some fifty miles through the monotonous scrub of the Muchinda plateau, we stood at the edge of a precipice dropping away abruptly at our feet and looked down with mixed feelings at the Luano Valley as from an aeroplane. It was to be our home for the best part of a year, and the place had an unwholesome reputation. The sun baked us as we climbed with hands and feet down the cliff.

The A-Luano, who give their name to the valley, are a stunted people. In every village there seemed to be more than the usual number of deformed children and case of goitre, and the chief of a kraal near our camp was a dwarf. The climate is bad; breezes sweep over the top, leaving the air below unrefreshed. It was curious to stand in perfectly still air and watch the clouds scudding overhead, with a higher layer racing in an opposite direction and a third stationary above all. Although we suffered only from minor complaints and were never really ill, malaria is common, and I was told afterwards that two American prospectors in a neighbouring district had sleeping sickness, one dying before I left.

The drop of 2,000 feet is a veritable frontier, separating two worlds. It seemed to me that neither in fauna nor flora was there anything in common between them. The plateau, between 4,000 and 5,000 feet above the sea, is a monotonous plain with scrubby bush growing out of schists and granites, barren and poor, but with air one can breathe. The valley below is covered with thick forest, with palms and baobabs, mopanés and aloes, Euphorbias and a host of other trees that do not grow on top. Its fauna is rich, varied and abundant, full of forms new to science.

LUSAKA AND MOPANE BUSH.
A view of the junction between the Lusaka and Mopané Bush, with a baobab in the background and a typical Mopané in foreground.

The bottom of the valley is flat. Where the Muchinda stream enters it is narrow but a little further to the north it widens; the average width is from twelve to fifteen miles. It is well watered. The Lunsenfwa, a tributary of the Zambesi, traverses it, and the Mulungushi enters it from the north-west by a fine waterfall which gives power to the mines at Broken Hill. It is to be noticed that these rivers do not flow *down* the valley, but cut *across* it. Its formation is due not to river action but to subsidence.

It was just above the junction of these two rivers that P. S. Nazaroff, the Russian explorer, and I camped for the greater part of a year. We had not been there long before I noticed that the vegetation fell into four clearly marked zones, each having a characteristic fauna, the Alluvial Zone, the Lusaka Bush, the Mopané Bush and the Schist Zone. The first comprises the mud and sand banks which are covered by water during the rains and yet have characteristic orthoptera, the reed beds, the grassy dambos and the creeper jungles, all teeming with life. In the latter occurs the buffalo bean (*Mucuna* sp.). When ripe the golden-brown pubescence comes off at the slightest touch, causing violent urtication. In the dry season the wind blows it some distance, so that one may feel afire when walking along the lee side of a stream.

From a height of about ten feet above the water to sixty or seventy there runs a belt of jungle parallel to the streams. This is the Lusaka Bush, a gloomy jungle of shrubs, thorns and spiny trees. The atmosphere is heavy and close and the light dim, but both fauna and flora are rich. Typical plants are the two Euphorbias,

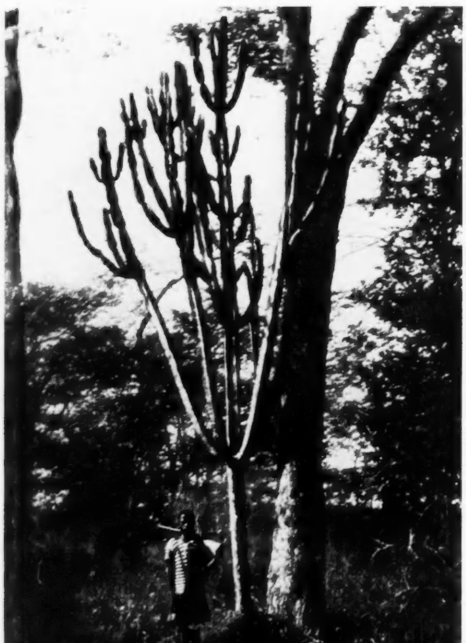
E. strangulata and *E. abyssinica*, which make impassable barriers with their spines and corrosive juice; the fibrous needle-tipped *Sansevieria*; a large and spiky tree; an occasional palm; mimosas; here and there a massive baobab, *Adamsonia*, of grotesque form with bark that looks like cast iron; and *Combretum eleagnoides*, a tree interesting entomologically.

Over the banks of the streams there often hang clusters of a scarlet bean, *Popowia obovata*, with a pleasant, refreshing juice, and the floor is usually covered with a sage-like herb, *Isoglossa floribunda*. The Lusaka Bush is very interesting to the entomologist but difficult to work. It is a local saying that it is better to walk three miles round a belt of it than half a mile through, and I agree. When I visited the Victoria Falls on my way home and saw the famous Rain Forest, I recognized my old enemy and was not impressed.

Further still from the water, on dry ground soil, is the Mopané Bush, so-called from the characteristic tree, *Copaifera mopané*, which flourishes where nothing else will grow. It is a slim, tall tree, with rugged bark like an elm and leaves paired like butterfly's wings. In this bush we have dry open country, with a clear view a hundred yards or more ahead and little undergrowth, so that one can walk freely in any direction; what there is is thorny. The mopané is a resinous tree, making good fuel; it has an interesting fauna with two species of grasshopper peculiar to it.

Here and there are isolated inliers of the schists of the plateau. The line of demarcation is sharp and may be mapped to an inch. The soil is frequently covered by pink pebbles. The flora is that of the plateau and the fauna is poor. I was struck by the scarcity of flowers in the valley, in marked contrast to Angola. A small red epiphyte was the only spot of colour, except the waxy pink flowers of an occasional aloe, a thing of delicate but fleeting beauty.

The soil is so sour that nothing can be cultivated except in the alluvium where the natives have their mealie patches. Yet the vitality of the trees is astonishing. I found a great baobab lying on the ground bent flush down at the roots, and yet flourishing in that prone condition. If a mopané be felled low down and a horizontal branch left with but a slight connexion with the stump, it will put out vertical shoots which grow into vigorous trees; the stump will continue to grow and so raise the horizontal branch into the air, with the shoots growing out, making a strangely rectangular picture. I have mistaken such a branch for a kudu bull.



TYPICAL EUPHORBIA.

The Lusaka Bush is a gloomy jungle of shrubs, thorns and spiny trees, and the Euphorbias are typical of the plants which flourish.

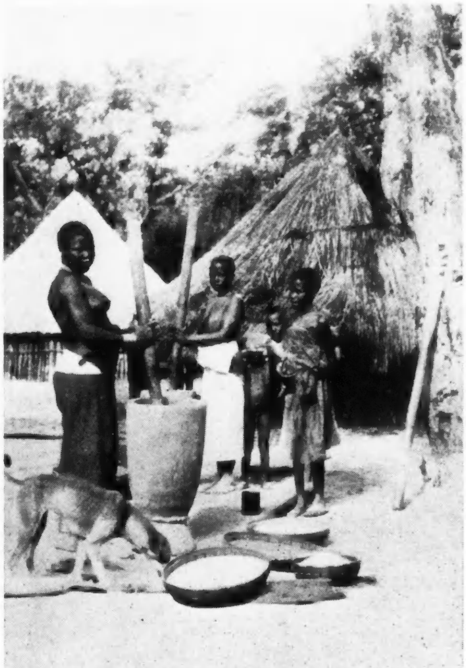
Food was one of the chief problems in the valley. Mealies for the porters were, at great effort and cost, brought out weekly from Broken Hill, and Nazaroff and I lived mainly on tinned food. We scarcely tasted fresh fruit or vegetables, except a few onions and tomatoes during the first few weeks when we had some mangoes. There were bananas but they always went bad without ripening. We kept our eyes open for game but shooting was impossible during the rains. In the dry season we got kudu and bushbuck fairly often and herds of mpala passed by sometimes. Eland were occasionally seen and there was an old bull roan that I flushed twice, once stumbling right on him asleep in some long grass. It is disconcerting to move an animal as big as a horse, and of course with a compass instead of a rifle in my hands. The only other edible mammal was the hideous bush pig. A herd of buffalo came by after I left, and we could hear hippo grunting but never saw one. Hyaena were in evidence as well as leopard and once or twice lion. At times we saw monkeys, probably vervet, in the Lusaka Bush and a pack of baboons haunted the banks of the Lunsenfwa.

Bird life was rich. There were numbers of a small bird, I believe the white-browed weaver, *Plocipasser mahali*, that built round untidy nests of grass at the ends of the lightest twigs of the mimosa, where no prowling animal could reach them. Screeching

black and white hornbills, I believe *Bycanistes buccinator*, chattered like magpies. The great hornbill, *Bucorvus caffir* called *ngomo*, the drum, all over Africa, soars like a vulture, but down there we never saw one, although during the rains we heard them every morning at dawn, "*Who, who, who took two?*" as clearly as possible. Turacos, *Gallirex, porphyreolophus chlorochlamys,* with voice like a xylophone, were common in the Lusaka Bush. I shot a *Pterocles*, probably *P. lichtensteini*, but it was uneatable. We shot and were glad enough to eat the ugly black and white duck with knobs on its head, *Sarkidiornis melanotus*. But the most important bird for us was the guinea fowl, *Numida mitrata*, of which I shot plenty in the dry season. The crested kind we did not see. One day I was startled to hear a loud roar just behind me. I spun round with my gun to the shoulder, expecting a lion on the attack, to see a great flock of tiny birds rise with a whirr from a clump of dried grass. They were not as big as sparrows but gave me quite a shock.

Reptiles were much in evidence, for we were not allowed to forget the presence of mambas for which the valley is notorious. They are aggressive and dangerous, but I do not believe they will attack a man without a grievance, real or imagined. Once I walked right on to one and was just in time to shoot it. It was exactly seven foot long and a formidable fellow. Hardly a day passed without killing a snake. A prospector with us insisted that the only kind of good snake was a dead snake, though I daresay we destroyed a number of vermin-eating allies at the same time. But we took no chances, as mambas are too swift, too numerous, and too dangerous.

Of pythons we saw only one small one, ten feet long. There are crocodiles, of course, in the Lunsenfwa, but small and shy. I stumbled on a pair of monitors, *Varranus niloticus*, which scuttled over the rocks, dived into the Lunsenfwa and swam off in a moment in the green translucent water.



A VILLAGE SCENE.

A-Luano women pounding corn in a typical village scene. Examples of native basket-work are shown in the foreground of the photograph.

There were many pests other than reptiles. Those who camped in the Lusaka Bush were tormented by small crustacea and sundry insects. Until we had cleared the site of our first camp in the Mopané Bush the grass swarmed with biting flies. Several species, all large and all bloodthirsty, buzzed into the shade of our tents in the daytime. Scorpions were noticeable towards the end of the rains, when I used to find them in my papers and clothes. As a rule they are sluggish, but once when I ripped the bark of a dead tree for earwigs, a shower of scorpions fell on me and raced away. Of driver ants we saw only one army. The big black Matabele ant, *Megaponera foetens,* often marched through our camp in military formation; we deflected their columns by sprinkling the ground with disinfectant.

My spare time and energies were given to collecting and observing Orthoptera. The material has been handed to the British Museum. The Orthoptera from the Luano Valley and Angola combined amounted to about 8,000 specimens, representing 600 species, of which about 100 are new to science. About half of these were probably from the Luano Valley.

The collecting of new species is not in itself as desirable as the accumulation of observations which is far more important, and I was glad to gather much of interest. In this I enjoyed one small personal triumph. In an early entomological monograph, I had described the *Eumastacidae*, a small group of grasshoppers of equatorial distribution which attracted me by their quaint appearance. In the preface I expressed the hope that one day someone would observe them in their native haunts and tell us about their manner of life, which might throw light on their oddity of structure. Time went by and the number of known species was multiplied by ten, but no information was received about the living insects. Thirty years later it was reserved for me, in the Luano Valley, to make the personal acquaintance of no less than five species of this group, alive in natural haunts.

Developing Empire Air Routes.

The number of pioneer flights to various parts of the Empire has been a spectacular feature of Imperial development in post-war years. The likelihood of a new American challenge to our records in the air is a striking tribute to British achievements. It is appropriate in this number to review the more outstanding flights.

THE flight to Australia, which is second in importance only to the crossing of the Atlantic, is outstanding among the pioneer Empire flights of recent years. It was first achieved thirteen years ago by two Australian airmen, the late Sir Ross Smith and his brother, Sir Keith Smith. Their time was a record which remained unbeaten for many years. Incidentally, it is largely due to Sir Alan Cobham's pioneer work that others have so brilliantly succeeded.

The Pioneers.

In February, four years ago, Mr. Bert Hinkler set up a new record for the 10,000 mile flight and was the first to make the attempt solo. His time of 15½ days has since been beaten several times, but it remains a remarkable pioneer flight. Mr. Hinkler's crossing from Port Natal, in Brazil, to Bathurst, on the west coast of Africa, although not an "Empire flight," may be mentioned as one of the greatest of Britain's many pioneer efforts.

Bad luck prevented Miss Amy Johnson from breaking the record in 1930 which Hinkler had set up, but her achievement ranks still as one of the greatest attempts ever made by a woman of any nationality. Within the last twelve or fifteen months the record both to and from Australia has changed hands many times. First in point of time comes the record set up by Mr. C. W. A. Scott in a De Haviland Gypsy Moth. His time from Lympne aerodrome, in Kent, to Port Darwin, a distance of 10,450 miles, was 9 days, 3 hours, 45 minutes.

Within a few weeks Scott was back in England, having achieved the unique distinction of breaking the record both to Australia and home again. His return journey was achieved in 10 days, 23 hours, and the last 1,350 miles, from Brindisi to Lympne, were covered in 13½ hours, despite very stormy weather. His homeward record stood only until August, when it was successfully challenged by Mr. J. A. Mollison, who landed at Pevensey 8 days, 21 hours, after he left Australia. Flying up the coast of Malaya and Burma at the worst time of the year, the monsoon weather compelled him to rely on his instruments to navigate through masses of low cloud and drenching rain. Across India, the intense heat added to Mr. Mollison's fatigue due to lack of sleep, and for most of the way he was obliged to fly without goggles.

Scott's outward record did not long remain unbeaten. By a margin of only a few hours it was broken towards the end of last year, but this year, in April, Scott, by a brilliant flight in the same machine in which he made his records last year, brought the time for the outward journey to only 8 days, 20 hours, 47 minutes.

Many brilliant flights have been made to the Cape, and here again the Empire has led the way. As in attempts on the record to Australia, British light aeroplanes have proved brilliantly successful. Although French airmen, flying the shorter distance from Paris, have achieved a faster time to the Cape, Mollison's flight of 4 days, 17 hours, 9 minutes, only a month or two ago in a De Haviland Puss Moth remains the record from England to the Cape, and is still the solo record. Mollison's success is of particular importance also, since he followed a new and shorter route not previously explored.

One of the most remarkable features of Britain's achievement in the air is the number of successful long-distance journeys made in small light machines, costing less actually than many high-powered motor-cars, and running on ordinary fuel and oil bought from existing local supplies en route.

Record flights are nowadays so commonplace that it is difficult to appreciate that it is no more than thirteen years since two British airmen, the late Sir John Alcock and Sir Arthur Whitten Brown successfully completed the first Atlantic flight from Newfoundland to Ireland. Their time of less than sixteen hours remained the record until only a few weeks ago. Despite many unsuccessful attempts, some ending in disaster, the return journey was not achieved until September, 1930. This is one of the few world flights in which British airmen have not led the way.

Human Endurance.

Day after day, with only brief halts and the minimum of attention, the light British machines have flown with faultless regularity, hundreds of miles through every extreme of climate. Non-stop flights of 1,000 miles or more are commonplace. The capabilities of the machine have largely ceased to be the governing factor in long-distance record attempts. Flights are limited now chiefly by a pilot's physical ability to continue without rest or sleep.

PIONEERS OF THE EMPIRE AIR ROUTES.

(Top left).—Mr. Bert Hinkler, who four years ago set up a record of 15½ days for the flight to Australia. (Top right).—Miss Amy Johnson, who was prevented by bad luck in 1930 from beating Mr. Hinkler's record. (Bottom left.)—Mr. J. A. Mollison (left), who holds the record for the journey to the Cape and succeeded in following a new route not previously explored. (Bottom right.)—Mr. C. W. A. Scott, who holds the unique distinction of having broken the record both to and from Australia.

Wool Research in New Zealand.

From a Dominion Correspondent.

Grazing industries provide about 95 per cent of New Zealand's exports, her annual wool clip being one of her four most important products. The growth of the industry in recent years has emphasized the value of scientific research on the breeding and feeding of sheep, and on the improvement of the Dominion wools.

Wool research, with particular reference to the problems of the manufacturer, has been actively prosecuted in England since the war, but on the production side it is yet in its infancy. It has been considered that many of the problems of the wool producer could best be undertaken in the countries concerned. In South Africa much valuable work of this type has been carried out by the Sheep and Wool Extension Officers of the Department of Agriculture, and in New Zealand a similar organization for the instruction of breeders of crossbred flocks is urgently required. Important investigations with regard to breeding and feeding have, however, been made within recent years by experts at Massey College (Palmerston North) and at Canterbury Agricultural College (Christchurch). Research into the breeding and feeding of sheep and into methods of packing and marketing is being carried on at the two Government agricultural colleges under the supervision of the Department of Scientific and Industrial Research and in close co-operation with research institutes in Great Britain.

The various defects found in New Zealand wools are elaborated in a recent bulletin by Mr. D. J. Sidey, of Canterbury Agricultural College, who states that the chief fault is the presence of irregular fibres. In crossbred wools this appears mainly in the form of variation in length along the fibre, or in marked variation in the size of fibres, accompanied by medullation. He has found that medullated fibres in New Zealand wool, particularly Romney wool, is low in sulphur content, a factor that affects the spinning quality. Mr. Aiken, a colleague, has discovered a correspondingly low sulphur percentage in New Zealand grasses, and it is possible that the manuring of pastures with ammonium sulphate may effect an improvement in the wool, checking the tendency towards medullation.

Food and Fibres.

Some form of thyroid activity may also be a contributing factor. Investigations carried out by Hopkirk and Dayus in the South Island indicate that where there is a deficiency of iodine in the feeding of ewes, lambs are born with enlarged thyroids and invariably have coarse coats of medullated wool fibres. Means of improving this class of wool seem in any case to lie along two main lines—the improvement of the nutritional condition of the sheep, and the selection within the flocks of rams and ewes with the desired type of wool. Correct breeding methods must accompany selection work.

Studying Wool Defects.

Until something more is known about the inheritance of medullated fibres, and the probable effect of completely eliminating them from the fleece, it will be difficult to recommend any measures other than these. Work carried on at Massey College, however, has produced a simple benzol test whereby the stud breeder can quite readily determine whether there is medullation in the wool of a particular sheep. This test is useful if it is desired to select one ram from two or more, equal in other respects, and also because it draws attention to the particular wool defect.

The presence of kemp in wool, a frequent defect in crossbred types, may render it useless for the manufacture of good serges and similar goods, though it may be quite satisfactory for other purposes. This defect may be eliminated by selective breeding. Investigations at Massey College suggest that if the growth of the wool is vigorous when the kemp appears, there will be a bad fleece later ; but that if the growth is poor at the time the kemp shows up, the fleece will eventually be quite a good one.

The importance of this lies in the fact that it will soon be possible to tell during the first few weeks of a lamb's life whether its first fleece will be kempy or not, and later work may point the way towards determining the whole history of later wool production, practically from the time of birth. This knowledge will be of great value. Many ewes are now killed indiscriminately for freezing purposes ; but with such accurate tests, only those ewe lambs would be killed whose fleece would not promise to be good after future growth.

Other projects under way at Massey College concern the rate of the growth of wool, methods of selecting representative samples, and the influence of various foods on the yolk or natural grease present in wools. The usefulness of wool-grease lies in the fact that it keeps the skin soft, and prevents irregularities in

the wool as it is pushed up through the openings of the wool-follicles.

The study of the inheritance of desirable and undesirable fibre types in the Romney breed, now proceeding in New Zealand, is the most urgent of the fundamental problems affecting the producer, and Mr. Sidey advocates its extension in a modified manner to include other breeds, especially the Corriedale. This is a comparatively new breed of sheep, raised by a New Zealand breeder, and is quite satisfactory. There is also room for an investigation of the effect of various mineral deficiencies on wool production, and the best method of solving these problems. The staff of Canterbury Agricultural College have in this connexion already outlined a scheme for measuring the effects of various types of top dressing and pasture management on the total production, both mutton and wool, of the sheep.

There is in New Zealand a wide field for inquiry into the preparation of the clip for marketing, and into marketing methods. The work of Mr. D. O. Williams, of Massey College, indicates the difficulty of arriving at any definite conclusion with regard to world production, demand and present-day supplies, and the necessity for a central institution for the compiling of wool statistics, after the style of that operating in the cotton market. The investigations of Dr. I. W. Weston into the economic aspects of wool production in Canterbury show the necessity for a similar survey of the whole wool industry in New Zealand.

The close co-operation of the English manufacturer with the New Zealand producer is also necessary if Dominion wool is to be improved to meet manufacturing demands. Though the advice hitherto proffered by manufacturers has generally assisted in wool improvement, some of their criticism has been misdirected, and even contradictory. Manufacturers have frequently failed to consider whether it is possible for the producer to put their suggestions into practice. What really is required is that the producer should grow the class of wool which will give him the best economic return, and that the manufacturer should make the best possible use of this class of wool, by the adaptation of his machinery or otherwise.

NEW ZEALAND SHEEP.
Driving sheep into the shearing shed on a New Zealand farm. The quality of the Dominion wool is steadily improving as a result of research. This photograph is reproduced by permission of the High Commissioner for New Zealand.

An Artificial Fibre.

The fall in wool prices in recent years has been a severe blow to the production of substitute fibres; woollen goods are now cheaper than at any time since 1914. In the case of some articles there is now an increasing preference for wool instead of artificial silk. This is partly due to the fact that artificial silk materials are neither as durable or as efficient for retaining heat as materials made from wool. What is most required to-day is an artificial fibre, akin to wool in chemical and physical properties, that can be more readily used for blending with the natural wool.

The field for future wool research in New Zealand covers a study of the inheritance of undesirable fibres in all breeds, and of the inheritance of the weight of wool produced; a study of the effects of feeding on wool-production, in regard to both quality and quantity; the determination of the effects on wool fibres of excess and deficiency of yolk; an extension of present endeavours to improve woolpacks and branding fluids; and an economic survey into wool production generally. The producer should in the meantime have regard to a regular supply of food for his flocks, and the careful selection of rams and ewes for breeding purposes. The stud-breeder, for his part, must endeavour to minimise the quantity of medullated fibre in wool, and, by a system of wool-weighing, to breed from strains within his flock which produce the heaviest fleeces compatible with quality.

In Bradford the general opinion is that New Zealand wool has definitely improved during the last few years, and that if these improvements can be continued the present ground for criticism will be removed. The New Zealand producer is steadily putting into practice the advice offered him by the scientist, and it is clear that research will eventually play as important a part on the sheep farm as it does at present in dairying.

Bird Watching on an African Peak.

By R. E. Moreau.

The author's studies of bird life in East Africa are well known to readers of DISCOVERY. *His exploration of the Usambara mountains in search of rare species was described in this journal last January. Mr. Moreau's latest work, of which he has sent us the following account, concerns the effect of altitude on bird distribution.*

FEW weeks in the year go by without an ascent of Kilimanjaro, the greatest of the African mountains, to the lower limit of its snows. For one can reach a height of 14,000 feet on the giant peak with less effort than is needed to climb Snowdon or Helvellyn. Yet surprisingly little contribution has been made to our knowledge of the ornithology of the mountain in the last twenty-five years.

A Little-known Route.

I made an ascent recently by a route that has been rarely traversed, for ninety-nine people out of a hundred use the Marangu track, which is provided with huts. I had two particular objects in view. I wanted to collect data for a study of the effects of altitude on bird distribution and to see whether it was really true that several species present on mountains both east and west of Kilimanjaro were unrepresented on the great mountain itself. To the popular reader the exact nature of the observations made will be of little interest compared with the general impressions gained.

Kilimanjaro, like many of the East African mountains, is an oasis in a dry steppe. The size of the whole mass is hardly realized. Its base is an oval quite forty miles by fifty, so that it would cover most of North Wales. At a height of between 13,000 and 14,000 feet there is an extensive plateau, from which rises abruptly the tremendous snowy dome of Kibo. Obviously there is room for a wide diversity on slopes so extensive, and the description of the zones encountered on one route is by no means necessarily applicable to another. In fact the diversity is increased by the unequal distribution of the rain fall. On the north there is semi-desert with no permanent streams even from the snow-cap ; on the south is some of the finest agricultural land in East Africa, cultivated by a singularly intelligent native race and by European settlers.

By the kindness of Pastor Müller, the doyen of the missionaries on Kilimanjaro, who came out in 1895, I was able to make Machamé on the south side my headquarters. It is a district of remarkable beauty, and not the least of its attractions is the tameness of the birds. The exquisite Cossyphas, the red-tailed birds whose songs are the finest of all the African voices, there pursue their insect prey on the open paths, while in other localities they skulk in thicket. The Louries, magnificent in green, blue and carmine, instead of burying themselves in the forest canopy, come into the gardens, nest outside the door of the mission, and raid the apple-trees.

As the path rises from the surrounding plain, which is already three thousand feet above the sea, but clothed with a parched " bush," it passes through a rich belt of cultivation, chiefly coffee and bananas. For the staple food of the Wa-chagga, like the Baganda is bananas. All the cultivation is supported by irrigation, because although the rainfall is high it is badly distributed. In their water-organization the Wa-chagga give evidence of their outstanding qualities. For the rivers fed by the snows above have worn themselves channels two and three hundred feet deep in the soft volcanic material of the slopes. To meet this difficulty the people lead off the water high up the mountain and bring it to their gardens in channels eight and ten miles long. This may seem a small thing to those familiar with the irrigation of other lands. Among an African people it is remarkable. So, incidentally, is the construction of the great stone church at Machamé, capable of seating three thousand people, which was built without European assistance of any kind.

Many Birds.

At Machamé itself, between about 4,800 and 5,200 feet, the native cultivation is intersected by long strips of common pasturage. The grass is as short as a golf green, somewhat over-grazed, but most lovely to look and walk upon after the harshness and rankness of most of East Africa's ground-cover. There in the northern spring the yellow-bellied wagtails forage in flocks, while in the copses blackcaps sing, not with their full English vehemence, but still with good voice. Birds abound in the native gardens, attracted to the hedges of bramble or aloe with which they are surrounded. There are long-tailed pied-shrikes, which sometimes impale their prey like our butcher bird, the striking yellow and black Reichenow's weaver, the pushful black-capped geelgat, who lives almost everywhere, eats a great variety of food, and seems to be prevented from inheriting the earth

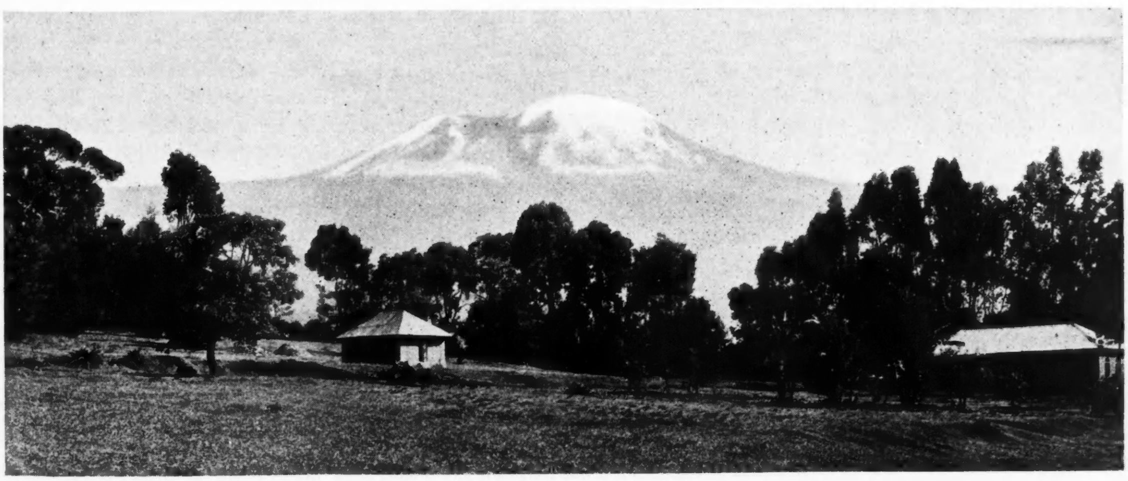
largely because it always builds its nest too small, so that its young fall out; the slaty-coloured fly-catcher with white spectacles; the lovely black whydah-birds with tails four times as long as their bodies and crimson hoods; the pintailed whydahs, black and white, which are, like cuckoos, dependent upon other birds to hatch and bring up their young.

There is a whole collection of little creatures, fire-finches, waxbills and mannikins so tiny that they weigh less than a quarter of an ounce each. Where the trees grow close together the paradise flycatchers build their exquisite small cups of green moss in the fork of a twig. No museum specimen can give any idea of the living beauty of these birds, for the vivid blue of their bill and eye-wattles fades as soon as they are dead. So bright is its colour that when the bird is sitting in some shadowed place its dark head melts quite into the background and the blue mark seems to hang in the air suspended and self-luminous. Their tails are very long and soft, so that they ripple behind their owners as they fly, like ribbons in a breeze. The song, too, is charming.

The ravines in which the rivers flow are in places forested and very lovely. The water, clear but somewhat brown from the mosses ten thousand feet above, flows over grey boulders and between miniature lawns where the sandpipers and wagtails run. Orange gladiolas grow on the banks. The fringing forests swarm with birds. There is a fiery-breasted bush shrike with his bell-note, the tiny stuttering trococercus, and several shy greenbul. Three kinds of starlings come with the great blue pigeons to the Raûwolfia berries and the wild olives. The black cuckoo chuckles in the undergrowth, the red-chested cuckoo shouts from a twig, the little bronze cuckoo whistles, the gold and emerald cuckoo, most gorgeous of them all, repeats again and again his "kulwa: tuoge" (let us bathe), from the crown of some tree in which, for all his magnificence, he is invisible.

At 5,800 feet the cultivation gives place to a heathy waste remarkably like a common anywhere in the south of England. It is a mass of bracken, man-high and more, in which are small islands of a bush (*myrica kilimandscharica*) a little like a sallow. Naturally in such an association species are few; there is nothing for seed-eaters to live on. The characteristic birds are the Zosterops, little green birds with a ring of silky-white feathers round the eye. There is, too, a brown Bradypterus, which occurs on many of the African mountains, but lacks any English name. It exhibits one of the characteristics of its genus, a perennially moth-eaten and thread-bare looking tail. In the bushes, over-wintering willow-warblers were in the latter half of February beginning to sing.

Just below 7,000 feet this homely heath gives place strangely and abruptly to an enchanted woodland. It is low-roofed and dark, the stunted trees quite out-numbered by the tree-ferns. All is smothered in moss, great muffs and swathings of it on every trunk and twig. It looks as if the wood has been sunk in the bottom of a pond and there accumulated water-weeds. But on the ground a scarlet and orange balsam blazes, and a begonia with sprays of dainty purple flowers ramps up the rough trunks. This wood is very silent. No bird calls but the bush-robin with



ON KILIMANJARO.
At a height of nearly 14,000 feet there is an extensive plateau from which Mount Kibo rises in the distance. The photograph is by Pastor Müller.

chrome-yellow under-parts and silver stars on his slate-blue forehead.

Bigger trees, chiefly Podocarpus, soon appear, and at about 8,500 feet the first Giant Heather. It is giant indeed, a full eighty feet high, but as one climbs it gets smaller and at the same time tends to exclude all other trees. The upper forest is comparatively poor in species. Like the heath below it contains nothing that a seed-eating bird can consume. Except for the Lourie, most of the birds are small and obscure, two little flycatchers (*Alseonax* and *Seicercus*), a *Bradypterus*, a hill-tit and a few more. There is one lovely sunbird, golden green with a scarlet breast. None of the Usambara-forest endemics that I particularly sought could be found.

Camp at ten thousand feet is a delight. The wood is composed of nothing but the Giant Heather, here about forty feet high but growing with exactly the same gnarled habit as our familiar plant. The ground is covered with golden-green moss, great banks and cushions concealing all the small inequalities of the ground. Purple orchids and a slender scarlet gladiolus grow thickly, and a violet spangles the moss. A little higher still, where the nights may be frosty even in summer, and only a narrow belt at about eleven thousand feet, the Kilimanjaro raspberry flourishes, with orange fruit nearly as big as a walnut. But there seems to be no bird to take advantage of it and no beast except perhaps the hyraxes. For some reason the famous Colobus monkeys do not visit these woods above Machamé.

All the time the heather becomes smaller and sparser, and Kibo is hidden by the edge of the plateau from which it rises. At 12,000 feet the fantastic Alpine vegetation comes into its own, the Giant Lobelia, the Giant Groundsel, and the Everlastings. There are still several species of birds, although even in the hot season, ice persists on the pools at ten in the morning. The white-naped ravens and the mountain buzzards swing overhead, though what they live on I cannot conceive. Two vivid sunbirds are confined to this bleak region; there is a cheerful Cisticola and a chat. Zebra and eland visit these uplands, and even the elephants occasionally ramble as high.

At 13,000 feet the edge of the plateau is reached abruptly. Forty miles away, past the ragged heights of Shira, the great cone and broken crate of Meru are visible. Kibo is near now; the glaciers shine green in the sun. But on the welter of black volcanic rocks life is left behind.

The First Congress of Prehistoric Sciences.

THE first meeting of the new International Congress of Prehistoric Sciences will take place at the beginning of August, and preliminary arrangements are now announced. The Congress is being held in London at the invitation of the Society of Antiquaries and the Royal Anthropological Institute, and Sir Charles Peers, Inspector of Ancient Monuments, will act as President. Among subjects to be discussed are Culture Sequences in East Africa, which will be introduced by Dr. L. S. B. Leakey. The Palaeolithic Cave Cultures of Palestine will be dealt with by Miss D. A. E. Garrod, who will describe the results of excavations on Mount Carmel, including the discovery of skeletal remains of Neanderthal man. Dr. Tschumi is to give an account of the discoveries of Lower Palaeolithic Age in Switzerland. The important question of climatic conditions in the Mesolithic Period, as illustrated by the vegetable remains of the North Sea area, will be the subject of a discussion to be opened by Dr. Erdtmann of Stockholm.

Dr. Siret will deal with the question of the Copper Age, a subject on which his prolonged study of Spanish archaeology makes him peculiarly qualified to speak; and Dr. Vouga will discuss the phases of the culture of the Lake Dwellings of Switzerland, a subject on which he is the foremost authority. Mr. C. L. Woolley on Ur of the Chaldees and Sir Arthur Evans on the relations of Knossos and Mycenae in late Minoan times are each dealing with fields peculiarly their own, which present problems much to the fore at the moment in archaeological discussion. They are expected to make important announcements in their respective subjects. The period of transition from prehistoric to historic times has unfortunately attracted all too few workers among British archaeologists. In this section communications have been promised, which deal with the settlement of the Saxons in the Upper Thames Valley, the Viking movements, the Cornish tin trade and the fascinating problem of the history and origin of the Picts.

A few only of the contributions to the proceedings are mentioned here; the subjects cover a wide range and many are of exceptional importance. The discussions are likely to be of the highest interest and may be expected to contribute materially to the advancement of archaeological studies. Over five hundred archaeologists from all over the world will attend, among them being names of such distinction as the Abbé Breuil, Dr. T. J. Arne of the State Museum, Stockholm and Professor McCurdy of Yale.

The Derby by Television.

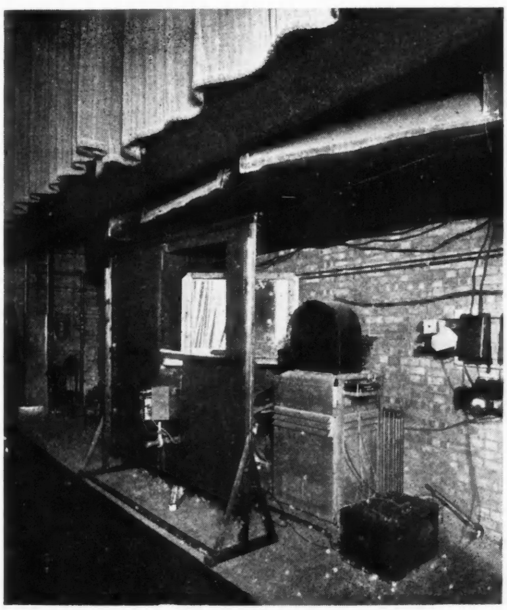
Two thousand people watched the Derby on June 1st from the Metropole Cinema, London. The finish of the race was shown on the screen at the same instant as it was being watched on Epsom Downs. The experiment was the first of its kind attempted in any part of the world, and is a notable advance in television transmissions.

AT 2.45 p.m. on June 1st the manager of the Metropole Cinema, London, Mr. Sowden, addressed the audience from the stage as a preliminary to the transmission of the Derby. He drew an analogy between the development of cinema films and television, emphasizing that while it was about thirty-five years ago that Lumière first showed his flickering pictures, it was only six years ago that Mr. Baird gave his first demonstrations of real television. The image was then the size of a postage stamp, but to-day it was large and bright enough to be seen on a cinema screen about 10 feet high by 8 feet wide.

After this introduction the audience was switched over to Epsom and through the loud-speaker heard the announcer, Mr. John Thorne, who provided a running commentary throughout the transmission. He was able to report that the conditions at Epsom were perfect, and though rain had fallen in London during the morning none had occurred on the race-course. But the anxiety of the engineers as to whether the experiment would succeed was shown by the extremely cautious remarks of the announcer before the race took place. He drew attention to the fact that the television apparatus was situated in a crowded stand on which the cinema photographers had pride of place and "rather obscured the view." He also mentioned that a breakdown in the telephone lines between Epsom and London reserved for the experiment had only been rectified a few hours before the race. Though the distance was only fourteen miles as the crow flies, the transmission had to be made over about thirty miles of telephone cable.

After a rather lengthy description of the ground and the crowds, the audience began to wonder whether the television pictures would appear at all. But a few minutes before three o'clock, when the horses came within range of the transmitter, the screen was illuminated, and it was possible to distinguish the grandstand and a section of the course in the flickering images which flashed across the screen. Then the famous parade began, and horse after horse was clearly seen as it passed in front of the television apparatus. It was difficult to distinguish details, and someone was heard to remark that the horses looked more like camels! Each jockey and horse appeared as a single moving object, but the general impression was excellent. At one moment three or four horses were seen on the screen together, and showed the greater range covered by this open-air transmission compared with the usual studio images.

An interval of some minutes followed, during which the announcer again described the scene, and then a great shout went up from the crowd, which was being heard faintly all the time as a background to the speaker's remarks. The race had begun! Immediately the screen was exposed again, and the audience was rewarded by seeing the winning horses flash neck to neck across the screen. A few seconds later the runners-up followed in twos and threes, these being more distinct than the winners, as they passed at a more leisurely speed. After the race it was possible to see the crowd moving on to the course, rather like a swarm of ants, and the winners were led past by their owners, though this was the least satisfactory part of the transmission.



BEHIND THE SCREEN.
A view of the apparatus behind the screen at the Metropole Cinema, described in the text. Notice the large plate-glass mirrors.

Everyone agreed that it was a very remarkable achievement, and when Mr. Baird was persuaded to show himself on the stage afterwards, he was greeted with tremendous

THE TRANSMITTING APPARATUS.

A view of the transmitter in the trailer-caravan opposite the grandstand at Epsom. The announcer described the race from the roof.

applause. He smiled but did not say a word; he had scored a triumph and left it at that.

A full account of the transmission appears in the current issue of our contemporary, *Television*. The diagram and photographs illustrate the way in which the experiment was carried out. The Baird daylight television apparatus was housed in a trailer caravan opposite the grandstand at Epsom and adjacent to the winning-post. Inside could be seen a large drum with thirty mirrors arranged round its periphery. This was revolved at a speed of 750 revolutions per minute, and since each mirror was set at a slightly different angle to the preceding one, the whole scene was in effect split up into thirty strips. A succession of images thrown by a lens on to the drum was thereby made to move over three apertures, which admitted the different degrees of light and shade comprising the scene to three separate photo-electric cells.

Each of the cells in its turn converted the light and shade effects into electrical variations of equivalent intensity. In this way the scene was split up into three adjacent zones and the separate signals passed to amplifiers, from whence they passed to telephone lines laid under the course for transmission to the Company's control room at Long Acre. From here they were relayed to the stage at the cinema, and after being further amplified were passed to the receiver.

The receiving apparatus was most ingeniously designed, and the photograph on the previous page makes this part of the scheme quite clear. Three small arc lights were set at the three points of a compass, each being responsible for one zone of the resultant picture. Three light valves (each a specially developed form of Kerr cell) modulated the beams from the arcs, and the resultant modulated light was thrown on to a single mirror drum geometrically identical to that at the transmitting end, and automatically synchronized. One of the light beams, namely the centre zone, passed direct to the drum, but the other two, since they were situated at right angles, were bent in their path by means of small mirrors.

The three beams of light were then reflected from the revolving mirror drum to a large plate-glass mirror set at an angle of 45 degrees, and in this way the beams were once more turned through an angle of 90 degrees to be projected on to the translucent screen on the Cinema stage. It was necessary to include this large mirror, owing to the absence of adequate depth in the back of the stage, and in consequence the mirror drum, instead of being at right angles to the screen, revolved in a plane parallel to the screen.

The Derby at Home!

The centre zone of the picture was broadcast by the B.B.C., and this wireless transmission was effected through the medium of the National transmitter on a wave-length of 261 metres. In this way it was possible for anyone in possession of a "Televisor" and a suitable wireless receiver to be able to watch the Derby in the comfort of their own home and, according to the many reports since received, this side of the transmission was a great success.

Reverting to the cinema, the three adjacent zones were carefully phased so that they would build themselves into a composite picture, and it was by this means that it was possible to make the screen so large. The simultaneous effect of sound and vision made a vivid impression and indicated the enormous progress recently made in television transmissions by wire and wireless. The experiment was repeated with the Oaks Race on June 3rd, and although the visibility was not so good as that on Derby Day, it was attended with equal success. The finish of the race was not so close, with the result that the horses were seen to better advantage as each passed the winning-post.

The opinions of the Press representatives who attended the theatre varied considerably, some being enthusiastic, others taking a very cautious view of

the results. For example, the *News-Chronicle* regarded the images as " big enough and clear enough to see the points of the horse's ears, its hooves and so on," while the *Daily Telegraph* thought them " too small and too indistinct to convey much information." The reports of the leading newspapers will be interesting to look back on in years to come.

The Times described the experiment as " reasonably successful considering the technical difficulties involved." The *Morning Post* said that the general level of reproduction was of a standard which a few years ago could have been achieved only under laboratory conditions. The *Daily Telegraph* suggested that the stage has not yet been reached when television can be employed for public entertainment. " The screen used was only a fraction of the size of the ordinary film screen, and the images projected on to it were too small and too indistinct to convey much information. The background might have been almost anything ; and the horses were too small and blurred to be individually recognizable. But at least people sitting miles away saw the Derby, and it needs little imagination to visualize the new marvels and fields of entertainment that this achievement opens up."

The impression of the *News-Chronicle* representative was that the vision was crude and with two black lines down the centre, just as if the picture were pasted up on three strips. " But it was the real thing. We could not tell what had won—the numbers were too indistinct—but we had seen the Derby won. The images were big enough and clear enough for us to see the points of the horses' ears, its hooves, and so on, but at the same time I could not tell you whether the owner or his jockey were smiling." The *Daily Herald* described the transmission as the most thrilling demonstration of the possibilities of television yet witnessed. " It made history. So distinct was the scene shown on a screen, nine feet by seven feet, that the watchers forgot the race in face of the miracle that brought it before their eyes."

DIAGRAM OF THE TRANSMISSION.
The general arrangement of the apparatus by which the images were transmitted from the race course to the cinema screen in London.

Book Reviews.

Principles and Practice of Geophysical Prospecting. Edited by A. B. Boughton Edge and T. H. Laby. (Cambridge University Press. 15*s.*).

The Imperial Geophysical Experimental Survey, of which this is the report, was undertaken under the joint auspices of the British Empire Marketing Board and the Australian Government. Its object was not to prospect for minerals, but to test the usefulness of various geophysical methods under field conditions in Australia, which is regarded as characteristic of considerable portions of the Empire. Field parties have worked in selected and widely separated areas in the six Australian states. Electrical, gravi-metric, magnetic, and to a limited extent seismic methods have been examined in country carrying sulphide and other ores, brown coal, graphite, saline waters, etc. Apart from the general report on field work, descriptions are given of the instruments used and of the procedure followed in the field. Accounts of the principles on which several geophysical methods are based have been included, and will be welcome to students of practical geophysics. The accounts of the electrical and electro-magnetic methods are particularly valuable, in view of the paucity of information available regarding these methods. The electrical method appears to have been treated by the companies employing it as a secret trade process and has been jealously guarded. Little information is therefore available regarding the methods employed, the apparatus required, the field operations and the interpretation of the results. A disclosure of the scientific facts should tend to place this method of surveying on a scientific footing similar to that of the gravimetric method.

The experience of the survey has shown that the outstanding applications for geophysical work in Australia are : Electrical surveys for base metal ores in Tasmania and in other parts of the Commonwealth, where the salinity of the surface and underground waters does not preclude the use of electrical methods ; electrical surveys in saline water-bearing districts with a view to determining the distribution and character of the underground water supplies ; gravimetric surveys in the brown-coal fields of Victoria and South Australia ; magnetic surveys over the sub-basaltic tin and gold deep-leads in New South Wales, Victoria and Tasmania ; seismic and gravimetric surveys in the sub-alluvial gold and tin deep-lead areas.

In many of the arid and semi-arid parts of Australia the electrical methods of prospecting for minerals are at a serious disadvantage on account of the high saline content of the underground waters. Salt water is, of course, a good conductor of electricity, and when the ground is permeated by it the conductivity between ore and country rock, upon which the successful operation of the electrical method depends, is usually reduced below the effective limits. To some extent the gravimetric methods have been superseded by seismic surveying, but some of the work carried out in Australia shows that there are certain types of problem which can best be dealt with by the torsion balance or the gradiometer. This is particularly the case in the investigation of small-scale structures. The applications of the magnetic method are connected with the discovery of highly magnetic ores, such as magnetite and pyrrhotite, and an excellent example of the work is provided by the magnetic survey carried out in Tasmania, where striking results have been obtained over bodies of tin bearing pyrrhotite.

The seismic method has been found to be applicable to simple structures in which one reasonably homogeneous formation overlies another. An example of such conditions was afforded in New South Wales, where a high velocity bed-rock is overlain by several hundred feet of unconsolidated alluvium. Under these favourable conditions, the form and depth of the lower formation can be found, and if the latter changes in character over a large area, this fact will also be disclosed. With some knowledge of local rock types, it is thus possible to establish the nature as well as the depth and form of a hidden formation.

Fertilizers and Food Production. By Sir Frederick Keeble. (Oxford University Press. 5*s.*).

As Sir John Russell showed in an article in *Discovery* last March, the use of fertilizers is now an established part of British farming practice. But although their application has strikingly increased during the last decade, it does not seem to have grown as rapidly in this country as in some countries abroad. Phosphatic fertilizer is widely used on grass land but the use of nitrogen fertilizers, which are no less important, is still comparatively limited. The aim of this book is to show that a large increase in home-grown food can be brought about—and brought about quickly by means of fertilizers. The plan adopted by the author is to divide the problem of increased food production into two parts. The first part describes the way in which fertilizers may be used to increase food production in the immediate future ; part two shows the way in which food production may be further increased in the more distant, but " by no means remote " future. In the first part the plight and scope of British agriculture are described. Evidence is brought forward to prove that fertilizers offer the most immediate and effective means of increasing food production, and estimates are submitted of the amount of increase which may be obtained by their more scientific use. Part II describes the further increases which would follow when a prosperous agriculture is able to take in hand the long-deferred work of draining and liming essential to the restoration of soil fertility.

Sir Frederick points out that the rate of increase in scientific knowledge of the use of fertilizers in enhancing soil fertility would become accelerated, and with each addition, " soundly based on science and well tried in practice," the fertility of the land would continue to grow. Discussing grass land, the author states that it has now been shown to be the superior, not the inferior, of arable land in its capacity for food production. " When its reserves of power at present unused are called up for active service, food production will receive the most powerful reinforcement which it is possible for it to get." Knowledge of the fecundity of grass is making rapid headway. It is beginning to be applied by many farmers in this country, but nowhere is it being put into practice more vigorously than in New Zealand, where thanks largely to the enterprise of the New Zealand Department of Agriculture, there are already three thousand farmers who are applying nitrogen and phosphatic fertilizers to their grass land.

Vital Records in the Tropics. By P. Granville Edge. (Routledge. 7*s.* 6*d.*).

Medical and administrative officers in the tropics are continually faced with the difficulty of collecting trustworthy " vital records " concerning the mode of life of the people among whom they are working. Some methods of approach to the problem are suggested by Mr. Edge, who is a member of the Division of Vital Statistics at the London School of

Hygiene. The taking of a census, for instance, in undeveloped territory among primitive people is hampered by many difficulties. The elaborate preparations invariably lead to the spread of disturbing rumours among superstitious races. The native usually suspects the Government of having in view some pecuniary gain; the counting is believed, for instance, to be the prelude to new taxation. Where a tax is suspected the census invariably leads to the concealment of very old people or young children, since it is clearly unfair to tax non-earning members of the community. In some countries the natives have supposed that a census was designed to discover those addicted to such innocent habits as carrying an umbrella, swinging an arm, and so on, with a view to introducing mysterious legislation for the correction of these faults. One native race firmly believed that a human head, sprinkled with a potent medicine known only to the white man, enabled him to discover the outcome of future events; and a census would provide a means of securing heads for this purpose! Many difficulties arise when attempts are made to discover the age, sex and religion of a native population, for the disclosure of this information is regarded as an invasion into the privacy of domestic life. The taking of a census among primitive societies therefore calls for extremely careful handling, and more intimate understanding of native customs than many administrators possess.

New difficulties are encountered in the selection of native agents; not in the lack of candidates, for these appear in embarrassing numbers, but because they are as a rule deficient in the necessary qualifications. The fact that definitions and terms do not convey the same impression when translated frequently leads to misunderstandings. Idols have been recorded and their sex stated, and female adults have been recorded as "adultresses." The religion of many individuals has been briefly discussed under the comprehensive term "convert," which is quite valueless.

This is primarily intended as a handbook for the administrator and medical officer, but there is much of interest to the layman. Mr. Edge is inclined to be verbose, but on the whole he has dealt satisfactorily with a difficult and complicated subject. There is a useful index to subjects and a bibliography at the end of each chapter.

The Geography of the Mediterranean Region. Its Relation to Ancient History. By ELLEN CHURCHILL SEMPEL. (Constable. 21*s*.).

The Mediterranean Sea and its bordering lands afford the natural conditions for unique rapid human development. In this volume an introductory account of the general geographical conditions clearly indicates how this region, compared with other areas of similar climate, combines the advantage of large area with a whole complex of other geographic advantages. The varied relief, location on an enclosed sea, command of a long indented coastline, access to three contrasted continents and other factors are all shown to contribute to the stimulating environment which left its mark upon ancient Mediterranean civilization.

The mountain and desert barriers encircling the area are described in detail in the following section of the book. The importance of the accessible approaches to the hinterland in determining the development of civilization is outlined from the earliest conflicts for the command of the trade routes onwards. Scant reference only is made to their continued importance after the collapse of the Roman Empire. But it was not the command of these peculiarly important areas alone that determined the rise, extent, and fall of these ancient Near Eastern and Mediterranean Empires. Depletion of the small forest reserves of the coastal areas, especially in the East, early intensified the advantages of commanding reserves of lumber in scattered coastal or hinterland regions. The paucity of alluvial valleys and coastal plains, combined with the effects of the climate, increased the importance of the wheat fields as the population of successive commercial centres increased faster than local production. The effect of these considerations is fully discussed in the section on "Vegetation and Agriculture." Here also the chapter titles "Pastures and Stockraising," "Manuring and Seed Selection," "Irrigation and Reclamation," "Pleasure Gardens" and "Climatic Factors in Settlement" indicate the comprehensive nature of the study the author has undertaken.

Regarding the changes of climate in historical times, especially fluctuations in rainfall, sufficient to explain the decline and fall of the Roman Empire, we are told that "arguments supporting this position have been advanced chiefly by historians, archaeologists, and other incompetent authorities not concerned with climatology. . . . Many facts of ancient and modern Mediterranean life point to marked stability of climatic conditions in historical times." In the final section all phases of marine activity, including that of successive bands of pirates in addition to that of legitimate trading interests, and the colonization ventures of each succeeding trading power, are given due prominence.

Throughout seven hundred pages, marked by a paucity of illustrations, this book maintains an attractive and readable style, though in places too great a mass of detail is apparent. But the long lists of authorities quoted at the end of each of the twenty-four chapters indicate what painstaking labour the compilation of this material has involved, as the text shows the author familiar with the large area under discussion. This volume is indeed a scholarly contribution of equal importance to the geographer and the historian.

The Great Age of Discovery. Edited by ARTHUR PERCIVAL NEWTON. (University of London Press. 15*s*.).

Modern Europe clearly dates from the adventurous period, about 1480-1520, when daring sailors commissioned by intelligent princes ventured forth on the ocean, found new lands and thus enlarged men's ideas of the habitable world. There is no better or more trustworthy short account of those astonishing achievements than is given in the new book edited and partly written by Professor Newton. He and his six collaborators are all well-known authorities on the period, and they can all write attractively. Moreover, the book is admirably produced, with plenty of reproductions of early maps, photographs of historic Spanish buildings and portraits of Ferdinand of Aragon, Vasco da Gama and Columbus.

The Portuguese were the pioneers. Prince Henry the Navigator, who died in 1460, organized the continuous series of voyages down the west coast of Africa, which led his countrymen of the next generation to the Cape and then to Mozambique and across the Indian Ocean to Calicut, and beyond to the Spice Islands. This wonderful story is told anew and authoritatively by Professor Prestage. Spain next took up the task, and the reasons why she entered upon it with such enthusiasm and performed it with such success are extremely well explained by Professor Pastor. His brilliant chapter on the Spain of Ferdinand and Isabella, animated by the half

mystical, half romantic crusading spirit which enabled it to conquer Granada from the Moors, is necessary to the understanding of the voyages of discovery. It was no mere lust for gold that induced the sovereigns to equip Columbus's expedition across the Atlantic. Moreover, Professor Pastor justly emphasizes the part that Castilian officials played in the organization and good government of the new lands. It was through no accident that the Spanish American Empire endured for three centuries and is still Spanish at heart, while the Portuguese Empire in the East Indies collapsed within a hundred years.

Professor Newton's two judicious chapters on Columbus and the Columbian controversy set out the facts. He makes it clear that the Genoese enthusiast who led the first Spanish expedition to America had no idea that he had found a new continent, but died in the belief that he had reached part of Asia. Columbus was no sailor and his theories of cosmogony were fantastic. But his missionary zeal found a response in Isabella, flushed with her victory at Granada, and he had the good fortune to be accompanied by experienced navigators in the brothers Pinzon. Professor Newton makes full use of the contemporary letters of Peter Martyr, the learned Italian ecclesiastic who was attached to the Spanish court and gave his friends details of the discoveries. This evidence is conclusive against the Columbian legend of Spanish ingratitude to the famous Admiral. Columbus proved incompetent to govern Hispaniola, or to appreciate the true significance of what he had found in the New World. But he was not deprived of his titles and died a wealthy man. It is to be noted that Professor Newton attaches much more importance to Amerigo Vespucci, the Florentine after whom the new continent was named, than Columbus's advocates would allow him. Peter Martyr believed in Vespucci, and the Spanish court made him pilot-in-chief of the India House so that he can hardly have been an impostor.

In the later chapters of the volume Dr. H. P. Biggar deals with the first explorers of the North American coast, Dr. H. J. Wood with the search for a western passage through America, Dr. J. A. Williamson with Magellan's voyage round the world, and Professor E. G. R. Taylor with the early attempts to find a north-west passage round the new continent. All these are lucid and accurate, and show how French and English seamen like Cartier and John Cabot joined in the task so well begun by the Portuguese and Spaniards.

Horns and Hooves. Handling Stock in Australia. By HENRY G. LAMOND. (Country Life. 8*s.* 6*d.*).

Mr. Lamond is a "horsey" gentleman, and an Australian one at that. His language is that of the big bush and the stockyard, as he explains in a foreword. It is effective up to a point, and in keeping with his subject; and it "lends atmosphere." But a little goes a long way, and after a few chapters of staccato slang Mr. Lamond becomes rather a tiresome person. But he can certainly claim to write with authority, and gives a vivid first-hand account of handling stock on an Australian ranch. Horses, sheep and cattle are dealt with separately in the three parts of the book. The author writes of sheep from long personal experience. As overseer, he has handled fifty-five thousand sheep in one "mob," and has counted forty-five thousand seven hundred without a break. He has marked six thousand four hundred lambs in eight hours, and has seen over five thousand a day pass over the board of a shearing shed. This gives some idea of the enormous scale on which sheep and cattle are farmed in the Commonwealth. Mr. Lamond's book has much to commend it, if one has the patience to pick out the facts from the rather too vivid local colouring. There are a number of excellent illustrations.

Hedgerow, Field and Wood. By HUBERT E. POUNDS. (Warne. 3*s.* 6*d.*).

It is a matter for satisfaction that wild birds may still be observed in numbers within a few miles of London. The encroachments on their territory of the suburban builder are inevitably driving the birds further out, but large numbers return to nest in their familiar haunts, and as Mr. Pounds observes, "on the outskirts of the Metropolis we may still find ourselves in the midst of Nature." All the birds described by the author are familiar to the Londoner and were observed in Surrey within fourteen miles of the City. The nightjar, whose odd "churring" note is so familiar is rarely seen, but it returns every year in May to nest in precisely the same spot, and the habits of several pairs have been observed by the author. Although there is no photograph of the adult bird, there is an excellent one of the young, in the apparently precarious nest lodged in the brake-fern.

The task of safeguarding wild birds in the neighbourhood of large towns is no easy matter. In the suburbs of London it is even more difficult. Where thirty years ago one could meet with the nightingale, goldfinch and linnet within a radius of seven or eight miles one must now go double that distance. Mr. Pounds rightly urges all bird lovers to do what little they can to prevent the defacement of the few remaining rural retreats near London and thus preserve the bird life which is rapidly being driven elsewhere.

Cambridge Excavations in Minorca. Part I: Trapuco. By MARGARET MURRAY. (Quaritch. 12*s.* 6*d.*).

Apart from Cartailhac's "Monuments Primitifs des Iles Baléares" the only published information on the archaeology of Minorca is contained in Spanish and Catalonian archaeological journals. This account of the Cambridge excavations, with its excellent illustrations, is therefore welcome. Minorca possesses a form of megalithic structure which does not occur elsewhere. This is the *taula*, a table consisting of a slab of stone set upright in a groove in the flat rock-floor. Various theories have been advanced to explain the taula, but as the monuments are peculiar to Minorca there is nothing with which to compare them. The suggestion that the stone table was an altar appears to be untenable in view of its height and the impossibility of reaching the top without a ladder. The theory which at present holds the field is that the taula was the central pillar of a domed roof covering an assembly hall in which the tribes met in council. In an introduction Dr. Murray examines this theory in detail, and eventually discards it in the light of the new excavations. She suggests that the taula can only have a religious significance. The identity of the Deity, however, is still unknown. The nature of the working suggests that the taula of Trapuco belongs to the Neolithic period.

In the first chaper Dr. Murray deals with the taula and the surrounding walls, and in the second chapter the adjoining buildings are described. Dr. Edith Guest contributes two chapters on the human remains and pottery. Parts of a very imperfect skeleton, probably male of about fourteen years, were revealed. The skull is of modern type but so fragmentary as to preclude precise measurement of any part.

There are a number of photographic plates and drawings, which enhance the interest of the text.

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